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New taxa and notes on *Helicteres* L. (Malvaceae: Helicteroideae) from the Northern Territory, Australia

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ABSTRACT

Six new species and a new subspecies of *Helicteres* from the wet – dry tropics of the Northern Territory, Australia are described and illustrated (*H. darwinensis, H. kombolgiana, H. macrothrix, H. serpens, H. sphaerotheca, H. tenuipila* and *H. cana* subsp. *latifolia). Methorium integrifolium* is reinstated as a species and a new combination is made in *Helicteres* (*H. integrifolia*) to accommodate it, while *Helicteres dentata* is reduced to subspecific level under *H. integrifolia*. Two varieties of *H. dentata* are raised to specific level (*H. procumbens* and *H. flagellaris*). A key to the 13 species known from the Northern Territory is provided and variation in some widespread taxa is discussed.

KEYWORDS: Malvaceae, Sterculiaceae, Helicteroideae, *Helicteres*, new species, *H. cana* subsp. *latifolia, H. darwinensis, H. flagellaris, H. integrifolia, H. integrifolia* subsp. *dentata, H. kombolgiana, H. macrothrix, H. procumbens, H. serpens, H. sphaerotheca, H. tenuipila.*

INTRODUCTION

The family Malvaceae *s. lat.* is cosmopolitan, especially tropical, in distribution with nine subfamilies, 113 genera and *c.* 5000 species (Mabberley 2008). It is widespread in tropical and temperate Australia. While the genus *Helicteres* L. has traditionally been included in the family Sterculiaceae (e.g. Cronquist 1981), more recent phylogenetic studies support its inclusion in a broadened Malvaceae (APG 1998; APG II 2003; Mabberley 2008). Subfamily Helicteroideae is one of the smallest subfamilies in Australia and is represented only by *Helicteres* which contains perhaps 60 species. *Helicteres* has a major centre of diversity in central and South America where some 38 species are recorded with an apparently lesser one in the Asian-Australian tropics (Christobal 2001).

The only Australian treatment for the genus is that of Bentham (1863) who recognised five taxa, all of which occur in the Northern Territory (N.T.). Additional Australian species have been described since that time by Fitzgerald (1918) and Mueller (1865). Wheeler (1992) provided the only modern Australian flora treatment, for the Kimberley Region of W.A. Recent flora treatments are also available for Thailand with seven species (Phengklai 2001) and for China with ten species (Tang *et al.* 2007). Four species were recognised for Java by Backer & Van den Brink (1963) and seven for British India by Masters (1874). Many of the east Asian and Malesian taxa appear to be relatively widespread with a few extending to Australia (Phengklai 2001; Tang *et al.* 2007).

In Australia, the incompleteness of available treatments and variability of leaf and indumentum characters especially has resulted in the misapplication of names. It has become evident over the past 25 years that a number of undescribed taxa occur in the northern N.T., Qld and W.A. A number of new taxa are described here in particular for inclusion in the *Flora of the Darwin Region*. As the type specimens of at least four taxa treated by Bentham (1863) are from the N.T., the clarification of the taxonomy of the N.T. species is of some value in progressing knowledge of the genus in Australia as a whole.

Christobal (2001) recognised seven sections within the genus, with only two of these (section *Helicteres* and section *Orthocarpaea*), occurring in Asia and Australia, the others being restricted to South and central America. As circumscribed by her, section *Helicteres* is monospecific including only *H. isora* L. while all other Asian-Australian species belonged to section *Orthocarpaea*. Section *Helicteres* was distinguished by the geniculate, pseudozygomorphic flowers with the upper petals distinct from the lower; the curved androgynophore which significantly exceeds the calyx; the petals with scattered minute glandular hairs or glabrous, red or orange or white, rarely white-green; stamens 10, usually connate at the base; one of the lower petals longer than the calyx; 2 (–5) flowered axillary cymes with extrafloral nectaries present; the androecium and gynoecium set at an angle on the androgynophore; the capsule spiral and the seeds without fins (Christobal *loc. id.*). She distinguished section *Orthocarpaea* as having 10 or fewer stamens; the androgynophore shorter than the calyx or just longer and always straight; the androecium

and gynoecium set at an angle on the androgynophore; the petals violet, the lower ones clearly differentiated from the upper and with a tuft of long glandular hairs; the capsule not spiral; the seeds without ribs; the axes of inflorescence with nectaries; and the flowers in simple cymes.

Herbarium abbreviations follow Thiers (2010). Only duplicates examined in the course of preparation of this treatment have been cited, except for unseen type specimens indicated by the abbreviation *n.v.* (i.e. *non visus* – not seen).

MORPHOLOGY OF SPECIES IN THE NORTHERN TERRITORY

Habit. All species are shrubs or subshrubs with either erect or trailing stems. Two primary resprouting forms are evident. Firstly, there are those with annual above-ground parts which resprout from a perennial rootstock either at or near to ground level. This group contains usually multi-stemmed perennial subshrubs either with erect or prostrate stems and includes *H. darwinensis, H. integrifolia, H. macrothrix* and *H. sphaerotheca*. In at least some members of the group which have been grown in cultivation (*H. integrifolia* subsp. *dentata* and *H. integrifolia* subsp. *integrifolia)*, the annual dying-back of above-ground parts and the low multi-stemmed, resprouting habit occur even in the absence of fire.

The second life form comprises taller, more erect, open, usually few-stemmed shrubs with lower stem regeneration as in for example *H. angustifolia L., H. isora* and *H. kombolgiana*. The open, much branched, few-stemmed habit of *H. kombolgiana* is maintained in cultivation. In some cases *H. isora* may be multi-stemmed after resprouting from fire but is typically taller and develops an open shrubby habit when fire protected. *Helicteres cana* and *H. hirsuta* Lour. are somewhat intermediate being few-stemmed but lower in stature, the former at least resprouting at ground level after annual fire.

Indumentum. Most vegetative parts and the calyx have sessile or stipitate stellate hairs with short or long multiangulate arms. The size of these hairs is often diagnostic of a species. The new growth often also has scattered, red, minute, digitiform, glandular hairs. A few species have long simple hairs on the upper surface of the leaf (*H. angustifolia, H. procumbens* and sometimes *H. sphaerotheca*), while most other species have only stellate hairs. Long or short, soft bristles (these bearing stipitate or sessile stellate hairs) are sometimes present on the calyx (*H. kombolgiana*) and are often present on the fruit (e.g. *H. hirsuta, H. integrifolia, H. macrothrix, H. temipila*). These bristles appear broadly comparable with those of *Triumfetta* fruit (Halford 1997).

Density of stellate hairs was classified into five classes: very dense, with the underlying surface obscured or nearly so; dense, with the branches touching to overlapping; moderately dense, with the hairs touching to 1 diameter apart; sparse, with the hairs 1–5 diameters apart; scattered, with the hairs more than 5 diameters apart.

Leaves. Leaves are simple, almost sessile to petiolate, the lamina usually has serrate margins or is sometimes entire, and in the case of *H. isora* (Fig. 1) also with short acute lobes lateral to the apex. Most commonly leaves are lanceolate to broadly ovate, less often linear (*H. cana* subsp. *cana*, *H. sphaerotheca*) or suborbicular (*H. cana* subsp. *latifolia*). In *H. darwinensis* the leaves appear at least partly accrescent, continuing to expand through the wet season until growth is apparently halted by the onset of dry conditions. Consequently leaves of specimens collected late in the wet season may be up to 180 mm long and thus many times larger than those present at flowering. The lower leaf surface in all species has a sparse to dense indumentum of stellate hairs, while the upper surface may be glabrous, or have stellate hairs, simple hairs or a mixture of hair types.

Stipules are usually subulate with an indumentum of stellate hairs.

Inflorescence. Cristobal (2001) recognised three distinct inflorescence variants, concluding that the partial inflorescence in *Helicteres* had undergone a progressive reduction from a symmetric or asymmetric double cincinnus to a simple multi-flowered cincinnus (e.g. *H. hirsuta*) and lastly to a 2-flowered or 1-flowered cincinnus. In turn these types of partial inflorescences may be arranged in a diversity of synflorescences. In the monospecific section *Helicteres* (*H. isora*) the cincinni are 2-flowered, rarely 3-flowered, while in section *Orthocarpaea* cincinni are basically 2-flowered or multi-flowered as in *H. hirsuta* and the south east Asian *H. viscida*. The basic inflorescence unit of a 1-, 2- or 3-flowered cincinnus is most common and in most taxa these are arranged in cymose inflorescences which may be contracted (e.g. *H. macrothrix*) to lax (*H. serpens, H. flagellaris*). In *H. hirsuta* the inflorescence is indeterminate, appears racemose, and can have up to 19 flowers with one flower, bract and extrafloral nectary per node. Cristobal (2001) interpreted this as a multiflowered cincinnus formed by reduction from a symmetric double cincinnus. There are no species with a symmetric or asymmetric double cincinnus.

Extra-floral nectaries. Sessile extrafloral nectaries are widespread in the genus and are present at the base of the pedicels on the internal face of the axis of the inflorescence in most species, including those considered here (Cristobal *loc. id.*). However, in *H. hirsuta* the gland is lateral to the base of the pedicel and on alternate sides of the rachis on successive flower nodes. These extra-floral nectaries are present in most taxa, with the notable exception of *H. procumbens,* and may be green, yellow-green or yellow when fresh but often drying dark to dark red. In all species, glands are sessile to slightly raised, orbicular to oblong or irregular depending on placement, smooth, glossy, glabrous and often depressed and darker in the centre. They appear to be frequented by a number of species of ants, including Green Tree Ants (*Oecophylla smaragdina*) and meat ants (*Iridomyrmex*).

Flowers. All species have flowers of the 'geniculate' type, in this case with the androecium and gynoecium set obliquely on the androgynophore rather than with the androgynophore or calyx set at an angle to the pedicel (Cristobal 2001). In these species the calyx is bilabiate and with the flower appearing somewhat zygomorphic (pseudozygomorphic of Cristobal 2001). Local species vary considerably from strongly bilabiate in *H. isora* and less so in *H. cana* and *H. hirsuta*, or weakly bilabiate, to virtually actinomorphic in species such as *H. darwinensis* and *H. procumbens* (Figs 2, 6, 9–11, 13, 15, 18, 20).

In *H. isora*, flowers last two days and are functionally male on the first day of opening and functionally female on the second (Winkler 1906, cited in Cristobal 2001). My observations confirm that there is a change in petal colour from pale blue to orange over the two days, and the limb of the petals is strongly reflexed and held against the calyx on the first day becoming perpendicular to it on the second (Fig. 1A.). The anthers are reported to be ripe on the first day and the stigma receptive on the second while nectar is produced by the calyx on the first and by the stigma on the second day. In other N.T. species, no change of flower colour is evident and longevity has not been investigated.

Calyx. *Helicteres* has a 5-lobed, weakly or strongly 2-lipped calyx, with the tube longer than the lobes (Fig. 7L). The calyx is green, subcylindrical, narrowly obconical, ellipsoidal or ovoid to campanulate. The lower three calyx teeth are usually distinct from the upper pair although otherwise similar in appearance. All species have a basal nectary gland but in most species except *H. isora* this incompletely covers the base of the calyx tube. In these species the gland is usually on the 'upper' side adjacent to the adaxial petals or sometimes lateral to the adaxial and abaxial petals and extends from 0.3 to 0.5 mm from the base, or in *H. hirsuta* 1 mm from the base. In *H. isora* the nectary extends upwards to *c.* 3 mm from the base and completely encircles the androecium and gynoecium. The margin of the gland may be irregular or entire. The calyx usually abscises from its base and persists loosely on the androgynophore through into the fruiting stage.

Corolla. The corolla of *Helicteres* is composed of five petals. Characters found to be useful to distinguish taxa included the degree of differentiation between the upper and lower petals, especially in the morphology of the claw and the relative length of the calyx and corolla (Christobal *loc. id.*). The upper (adaxial) pair and lower (abaxial) three petals may be weakly to strongly dimorphic but are always clawed with a cuneate limb and one or two appendages at the base of the limb (rarely absent). These structures have been variously referred to as aurieles, auriculate appendages, (lateral) teeth, or erose crests (Bentham 1863; Masters 1874; Fitzgerald 1918; Wheeler 1992: Cristobal 2001; Phengklai 2001). The appendages on the lower claws are less robust and less well developed than those on the upper petals. The two upper petals tend to be imperfect mirror images of each other, as is also the case for the two outer, lower petals (Figs 3D, E, J, K, 7C,E). The upper petals especially differ slightly in the placement of appendages. When dissected out and laid flat, the upper pair often curve towards each other, while the outer lower petals curve away from each other (Fig. 7C, E). The central lower petal is usually close to straight and symmetric.

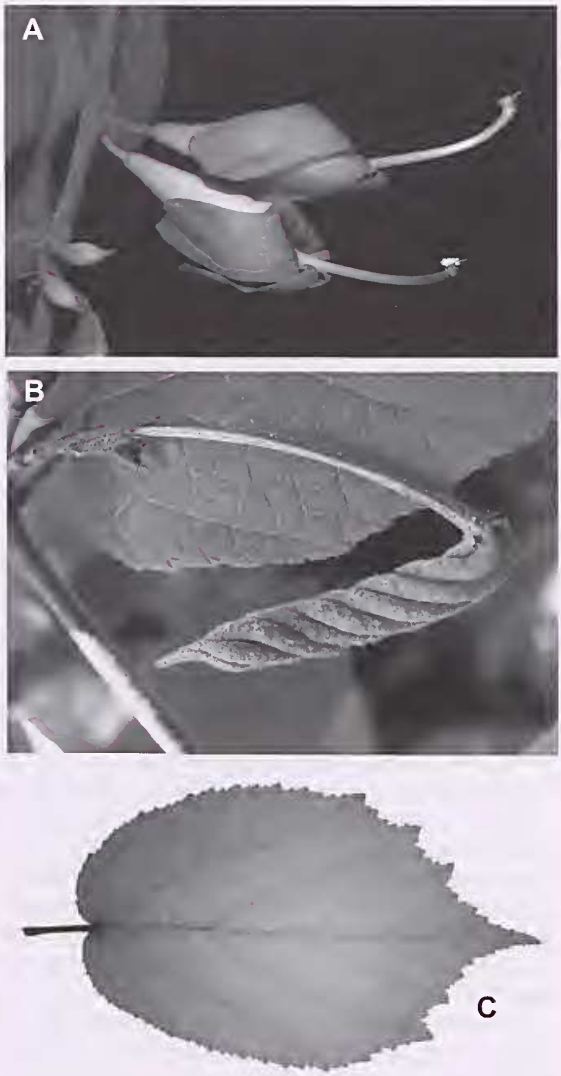

Fig. 1. *Helicteres isora*: **A**, flowers; **B**, fruit; **C**, leaf. (*I. D. Cowie 3272*).

In *H. isora* the limb is strongly geniculate or reflexed, while in *H. cana* and *H. hirsuta* the petals are bent at 90 degrees. In other taxa the petals are arcuate so that the limb curves out to about 90 degrees with the claw. The limb of petals is usually mauve to mauve-pink or pink, rarely maroon (*H. hirsuta*). In *H. isora* the petals are very pale blue on the first day changing to pale

orange in the evening and becoming darker orange on the second day. The upper petals in a number of species (*H. cana, H. darwinensis, H. integrifolia, H. kombolgiana, H. macrothrix, H. procumbens, H. tennipila*) are white at the base of the limb, corresponding to the glabrous area discussed below. The lower petals are usually uniformly coloured to the base of the limb, although in *H. darwinensis* frequently longitudinally striate or striped at the base of the limb and in some others darker. *Helicteres hirsuta* has a paler area at the base of the limbs of the lower petals.

Most species have sparse, patent to appressed, septate, apparently glandular hairs *c.* 0.1 mm long over the limb and similar but slightly longer hairs on parts of the claw. In three species (*H. cana, H. hirsuta* and *H. isora*), the base of the limb in all petals is smooth or with scattered minute, erect, glandular hairs and lacks an area of matted hairs on the inner surface. However, in other species the lower three (abaxial) petals have a distinct area of matted, simple, septate hairs to 1 mm long at the base of the inner surface of the limb while the upper (adaxial) petals have a smooth, glabrous, thickened and raised area at the base of the limb (Fig. 7). *Helicteres isora* has dark coloured, capitate, sessile glands of varying size scattered over the claw and base of limb of the upper petals and at the base of the limb on lower petals.

In the lower (abaxial) three petals the appendages are 'lateral' (on the margin and in a plane with the surface of the petal) whereas in the upper petals one appendage is 'sublateral' (at the margin but near to perpendicular to the surface of the petal) and the other 'medial' (located towards the centre between the margins and near to perpendicular to the surface of the petal). These lateral appendages help to hold the claws in a pseudo-floral tube while the sublateral and medial appendages serve to position the androgynophore and hold it away from the adaxial petals, leaving a clear path over the obliquely set stamens and stigma to the base of the calyx and corolla. This open tube on the upper side of the androgynophore presumably facilitates the access of insect or bird nectivores to the base of the flower and serves to enhance pollen transfer. While flowers, or at least the inflorescences, of most species are frequented by ants it is unclear if these play a role in pollination or harvest nectar from the flowers.

Androgynophore. In N.T. species of section *Orthocarpaea*, the apex of the androgynophore is just exserted from the calyx and floral 'tube' although in *H. cana* it is more strongly exserted. In *H. isora* (section *Helicteres*) the androgynophore is curved and greatly exceeds the reflexed corolla lobes. The androecium and gynoecium are mounted obliquely on the androgynophore and orientated adaxially in all species (Fig. 1A). In most species of section *Orthocarpaea*, the androecium and gynoecium rest on or just past the area of matted hairs on the lower petals. In *H. darwinensis* and *H. macrothrix* they may be virtually obscured by these hairs.

Androecium. All species have an inner whorl of 5 minute staminodes and an outer whorl of 10 equal stamens, free or fused at the base. The staminodes are shorter than the stamenal filaments and narrowly oblanceolate to spathulate, but acute. Stamens are shorter on the adaxial side of the flower. In most species, anthers are ditheeal and transverse but usually inclined slightly inwards at anthesis. In *H. hirsuta* the anthers are introrse at anthesis. Nine pollen types have been recognised for the genus (Pire & Cristobal 2001).

Gynoecium. The ovary is hairy and the styles are always connate, straight and may be twisted or not, even in species with non-twisted carpels. In *H. isora* the style and stigma are bent at 90 degrees to the axis of the stamens. In other species the style is parallel or slightly oblique to the stamens.

Within the Thai species of section *Orthocarpaea*, Phengklai (2001) recognised three taxa as having flattened slightly 5-lobed stigmas (*H. angustifolia, H. elongata* and *H. hirsuta*), the others having a simple stigma either narrowed to a point or with 5 pin-like teeth. These stigma types can also be recognised in N.T. taxa; they are distinctly flattened in *H. hirsuta* and straight with 5 cohering pin-like lobes in *H. cana, H. darwinensis, H. integrifolia* and *H. isora*. In *H. cana, H. integrifolia* subsp. *dentata* and *H. procumbens* at least, the stigmas may diverge slightly at the apex. However, in contrast to Phengklai's findings, Australian and Malesian material of *H. angustifolia sens. lat.* that I have seen appears to have a style consisting of 5 pin-like lobes, slightly expanded towards the apex.

Capsule. The fruit is a capsule and in *Helicteres* is composed of five unilocular carpels and may be ovoid to ellipsoid or subcylindrical. With the exception of *H. isora* (Fig. 1B), all species have straight valves and even in this species valves, although normally twisted spirally, may sometimes be partly straight, incompletely twisted or even with the twist reversing (e.g. *Booth 23*; *Cowie 12406*; *Scarlett 16*). The carpels dehisce along the inner suture, becoming partly separated with age. The indumentum varies considerably in density and hair size and the presence or absence of soft bristles. In descriptions, capsule dimensions include the layer of bristles or other indumentum. In some taxa (e.g. *H. angustifolia, H. cana*) the styles may at times be accrescent and the apex of the beak becomes apiculate as it develops

Seeds. The seeds are arranged in a single row in each carpel, together forming an elongated mass, flattened or angled laterally along the inner angle of the carpel and cut obliquely to transversely between the seeds. Thus the basal and terminal seeds are conoidal or sub-conical and the central ones sub-rhomboidal to sub-cylindrical with the adjoining ends obliquely truncate, or if the capsule has one seed it may be ellipsoidal and flattened. The size and number of seeds varies from numerous and about 2 mm long in *H. isora*, to few and more than 3.5 mm long in a number of species.

RELATIONSHIPS OF NORTHERN TERRITORY SPECIES

While *H. isora* is clearly distinct at the sectional level, within species of *Helicteres* section *Orthocarpaea* four loosely-defined groups can be recognised.

Helicteres cana group (*H. cana*): Plants erect, the indumentum is fine, leaves are virtually entire, with both surfaces densely hairy, the corolla is distinctly 2-lipped, the lower (abaxial) petals lack an area of matted hairs, petals are more strongly bent, relatively long, and the androgynophore is clearly exserted.

Helicteres hirsuta group (*H. hirsuta*): Similar to *H. cana* except the indumentum is coarser, leaves are toothed, discolorous, the inflorescence is racemose and indeterminate, the androgynophore is scarcely exserted and the anthers introrse at dehiscence.

Helicteres darwinensis group (*H. darwinensis, H. macrothrix, H serpens*): Plants are prostrate or erect, the indumentum coarse, leaves serrate, relatively large, weakly discolorous, corolla not or scarcely 2-lipped, relatively large, abaxial petals with matted hairs, androgynophore as long as calyx.

Helicteres integrifolia group (*H. angustifolia, H. integrifolia, H. kombolgiana, H. procumbens, H. sphaerotheca, H. tenuipila,* with *H. flagellaris* perhaps transitional to the previous group): Plants are erect or prostrate, the indumentum often fine to coarse, leaves usually serrate, usually discolorous, corolla weakly 2-lipped, abaxial petals with matted hairs, relatively small.

CONSERVATION STATUS OF NORTHERN TERRITORY SPECIES

The conservation status of all species has recently been reassessed against IUCN criteria following IUCN guidelines as part of a five-yearly review of the conservation status of the N.T. flora (IUCN 2001, 2003; IUCN Standards and Petitions Subcommittee 2010). Most species have been assessed as IUCN Least Concern. *H. tenuipila* is regarded as Near Threatened partly because of its restricted distribution. Among the factors contributing to the Endangered status of *Helicteres macrothrix* are past and projected loss of populations due to land clearing for horticulture, subdivision, railway or road maintenance and quarrying. Both species are threatened to varying degrees by invasion of habitat by the perennial weed Gamba Grass (*Andropogon gayanus*). The resulting changes in fire regimes, soil hydrology, nitrogen availability and light are serious developing threats (Cowie, Kerrigan & Stuckey in press; J. Westaway & I. Cowie unpubl.).

Fig. 2. *Helicteres cana* subsp. *cana*. Flowers and leaves. (*I. D. Cowie 11800*).

TAXONOMY

Helicteres cana (Schott & Endl.) Benth., 1863

(Figs 2, 3A,B, 4)

Methorium canum Schott & Endl., *Meletemata Botanica* 29, t. 5 (1832).

Type Citation: "*Habitat in Novae Hollandiae tropicae septentrionalis sinu Carpentaria*" [Australia, N.T., 1803], *F. Bauer s.n.* (HOLOTYPE: ?BP, *n.v.*).

Description. Open shrub to 2 m tall, stems 1–several, sparingly branched, often grey or grey-green. Stems and both leaf surfaces hoary, densely and shortly stellate-puberulous with hairs 0.1–0.5(0.7) mm diam.; calyx and capsule densely and shortly stellate-pubescent with stellate hairs and straight or flexuose bristles to 3 mm long. Stipules caducous, linear, 2.2–12 mm long. Petiole 3–13 mm long. Leaf lamina laneeolate to ovate, less often linear, narrowly oblong, suborbicular or very broadly obovate, 27–150 mm long, 7–88 mm wide, 1–11 times longer than wide, concolorous to weakly discolorous, often folded longitudinally, base broadly attenuate or rounded to cordate, 3–5-nerved, closely reticulate and raised on under surface, margins entire, rarely toothed in upper half, apex acute to obtuse or rounded, sometimes apiculate or shortly acuminate. Inflorescence axillary, cymose, contracted, 2–many-flowered, dichasia 2-flowered; extra-floral nectaries present; bracts linear, 1–5 mm long; pedicels 1–3 mm long. Calyx tubular to ellipsoidal, 6–11 mm long, basal nectary incomplete, margin minutely irregular; lobes triangular, 1–3 mm long. Corolla 2-lipped. Petals mauve, slightly dimorphic, 10–20 mm long, 3.5–5 mm wide, long-clawed, cuneate-spathulate, with scattered short simple spreading to patent hairs, apex truncate to obcordate; lower 3 petals narrower than upper pair, on the inner surface with (0) 1 or 2 lateral auricles at base of limb, pad of woolly matted hairs absent; upper pair petals on the inner (adaxial) surface with one lateral and one medial or sublateral auricle at base of limb, with a glabrous glossy, slightly callused area just above auricles. Androgynophore 7.5–14 mm long, straight, medially with scattered, short simple hairs, longer than calyx; stamens 10, scarcely connate at base, 1–1.5 mm long; anthers transverse; staminodes 5, laneeolate to narrowly oblaneeolate, 0.5–0.7 mm long. Style 1–1.2 mm long, straight; stigma of 5 pin-like lobes, terete, diverging

slightly at apex. Capsule ellipsoid to oblong, 7–32 mm long, 7–11 mm diam., apex shortly beaked or not; carpels straight, 2–7-seeded. Seeds variable in shape, sub-rhomboidal to conoidal, laterally compressed, 2–3 mm long, 1.5–2 mm wide, finely rugose, dark brown. Flowers and fruits: most months.

Distribution and ecology. The species is endemic to Australia (N.T., Qld). It occurs in the northern N.T. and on nearby islands of the Gulf of Carpentaria, Qld, and grows in open *Eucalyptus*-dominated vegetation, usually on well drained sandy or stony soils.

Notes. The species is characterised by the hoary, concolorous or weakly discolorous leaves, fine indumentum, the lack of a woolly or smooth, glossy callus on the lower (abaxial) petals and the androgynophore which is distinctly longer than the calyx. It differs from *H. angustifolia* especially in that leaf laminae are concolorous or weakly discolorous and the upper surface of the lamina is densely and shortly stellate-tomentose and hoary; the petals lack a woolly or smooth, shiny callus; the calyx, corolla and androgynophore are all longer than for *H. angustifolia*.

Schott & Endlicher (1832) provide a detailed illustration of *H. cana,* leaving no doubt as to the application of the name and cited a Bauer specimen from the northern Gulf of Carpentaria as the type specimen. However, it is not immediately clear if this specimen is part of the same gathering as a Brown collection at BM labelled in Brown's hand "*Orthocarpus incana*, North Coast" (duplicate MEL222172) and apparently collected from Sweers Island (island a), Gulf of Carpentaria on 17 Nov 1802 (Stearn 1960). The specimen attributed to Bauer could represent either a separate gathering or part of the Brown collection retained by Bauer for illustrative purposes. The taxon is common in eastern Arnhem Land and Bauer would probably have had opportunity to gather material from a number of places from Groote Eylandt north to Arnhem Bay. This area fits better with the 'northern Gulf of Carpentaria' locality given by Schott & Endlicher (1832) than does Sweers Island which is in the southern Gulf of Carpentaria. For these reasons I treat the Brown and Bauer collections as distinct gatherings. An additional sheet, MEL (222171), labelled "*Helicteres* aff. *H. cana*, North Coast" and collected by Brown is in fact *H. integrifolia* subsp. *dentata*.

As recognised here, *H. cana* is variable in the size, shape and degree of folding of leaves, the degree of serration of the margin, the distance the main lateral veins extend up the leaf lamina, and in the length of the fruit and indumentum. Using these characters two geographically distinct entities can usually be distinguished. However, specimens displaying intermediate attributes do exist in the Pine Creek to Nitmiluk N.P. area and this fact, coupled with an absence of critical features on regenerating plants (e.g. *Cowie 6068*), has led me to recognise them as subspecies, subsp. *cana* and subsp. *latifolia*.

1 Leaves mostly strongly channelled (or folded longitudinally when dry), lamina linear to ovate or elliptic, 2–11 times longer than wide, major lateral veins mostly extending less than 50% of lamina length, margin usually entire in upper half; capsule 7–20 mm long..... subsp. *cana*

1: Leaves not strongly channelled or folded longitudinally, lamina ovate or elliptic to suborbicular or very broadly obovate, 1–3.1 times longer than wide, major lateral veins mostly extending more than 50% of lamina length from base, margin usually at least partly serrate in upper half; capsule 14–32 mm long .... subsp. *latifolia*

Helicteres cana (Schott & Endl.) Benth. subsp. *cana*

Other specimens examined. NORTHERN TERRITORY: McArthur River Station, CSIRO paddocks, 14 June 1985, *M. Andrew 1009* (DNA); Cape Arnhem, 7 March 1995, *M. Barritt 1741* (DNA, MEL); Nhulunbuy, Whitewood Rd, 3 February 1997, *R. Booth 1399* (DNA); Nhulunbuy, Gaynagaru Walk, 5 February 1997, *R. Booth 2137* (DNA); Kakadu N.P., near Coronation Hill gate, Gimbat, 6 March 1991, *K. Brennan 1146* (DNA); Kakadu N.P., Gimbat, 6 April 1990, *K. Brennan 218* (DNA); 15 km WSW of Cape Arnhem, site B9, 14 February 1994, *K. Brennan 2439* (DNA); Kakadu Stage 3 Fauna Survey, site 14, 19 April 1990, *K. Brennan 3 & T. Orr* (DNA); English Company Islands, Inglis Is., 7 September 1996, *K. Brennan 3321* (DNA); M15, MacArthur River mine lease, 7 April 2003, *K. Brennan 5889 & K. Metcalfe* (DNA); Kakadu N.P., lookout hill near Coronation Hill, 8 August 1990, *K. Brennan 694* (DNA); Gove, Latram River, 20 May 2008, *K. Brennan 7688* (DNA); Carpentaria, 1802, *R. Brown s.n.* (MEL, NSW); 3 miles [4.8 km] S of Larrimah, 5 February 1969, *N.B. Byrnes 1354* (DNA, NT); Borroloola, McArthur River road, 7 April 1970, *N.B. Byrnes 1854* (DNA, NT); 16 km SW of Goyder River crossing, 16 June 1972, *N.B. Byrnes 2638* (CANB, DNA, K, L, NSW, NT); Arnhem Land, Maningrida-Oenpelli road, 19 July 1987, *M.J. Clark 1171* (DNA); Arnhem Land, 3 km NE of Bulman, 16 September 1987, *M.J. Clark 1191* (DNA); NE Arnhem Land, 29 September 1987, *M.J. Clark 1521* (DNA, MEL); Nhulunbuy, 200 m S of ovals, 1 March 1985, *P. Cleminson 18* (DNA); Gove Peninsula, August 1974, *J.F. Cooper s.n.* (NSW); Arafura Swamp, old homestead, 19 May 1990, *I.D. Cowie 1233* (DNA); west of Old Arafura, 22 May 1990, *I.D. Cowie 1311* (DNA, MEL); S of Ramingining, 22 May 1990, *I.D. Cowie 1312* (BRI, DNA, MEL, PERTH); McMinns Bluff, near Pine Creek, 25 January 1991, *I.D. Cowie 1472 & C.R. Dunlop* (BRI, CANB, DNA, MEL); Groote Eylandt, 5 km N of Angurugu, 10 September 1991, *I.D. Cowie 1997 & P.S. Brocklehurst* (BRI, DNA); Groote Eylandt, 1.3 km NNE of Angurugu, 11 April 1992, *I.D. Cowie 2567* (BRI, DNA, MEL); Arnhem Bay, Raymangirr, 22 May 1992, *I.D. Cowie 2788* (DNA); Nth

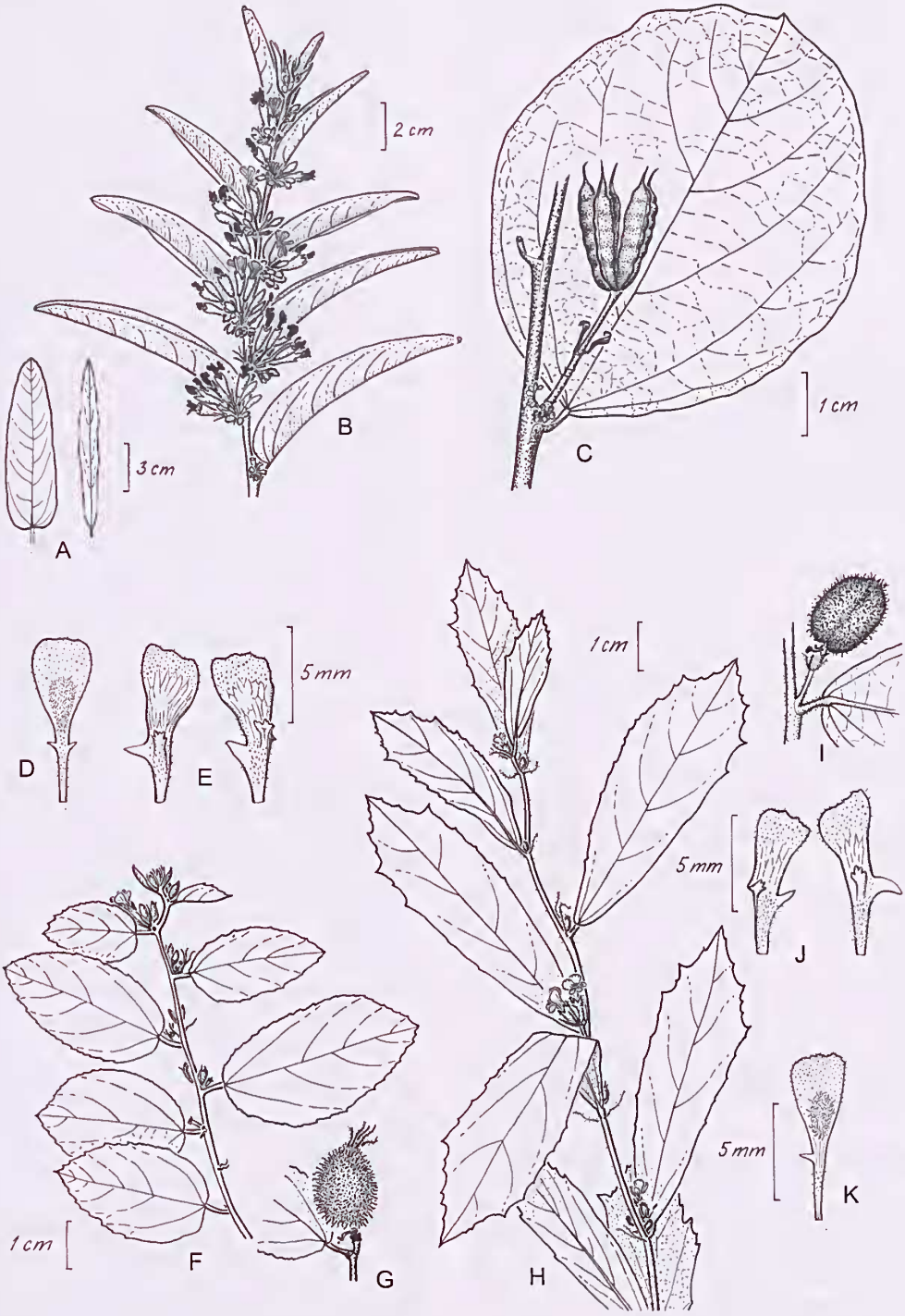

Fig. 3. A, B. *Helicteres cana* subsp. *cana*. **A**, leaf shape variation (Clark 1521, Blackshall 68); **B**, flowering branchlet (Clark 1521). **C**. *Helicteres cana* subsp. *latifolia*: fruiting branchlet (Cowie 976 & Estbergs). D–G. *Helicteres kombolgiana*. **D**, central lower petal; **E**, upper petals (D–E, Cowie 12530); **F**, flowering branchlet; **G**, fruit. (F–G, Egan 4528). H–K. *Helicteres tenuipila*. **H**, flowering branchlet (Cowie 3269); **I**, fruit (Cowie 5347 & Taylor); **J**, upper petals; **K**, central lower petal (J–K, Cowie 10361 & Egan, type). Scale bars: A = 3 cm, B = 2 cm, C, F, G, H, I = 1 cm, D, E, J, K = 5 mm.

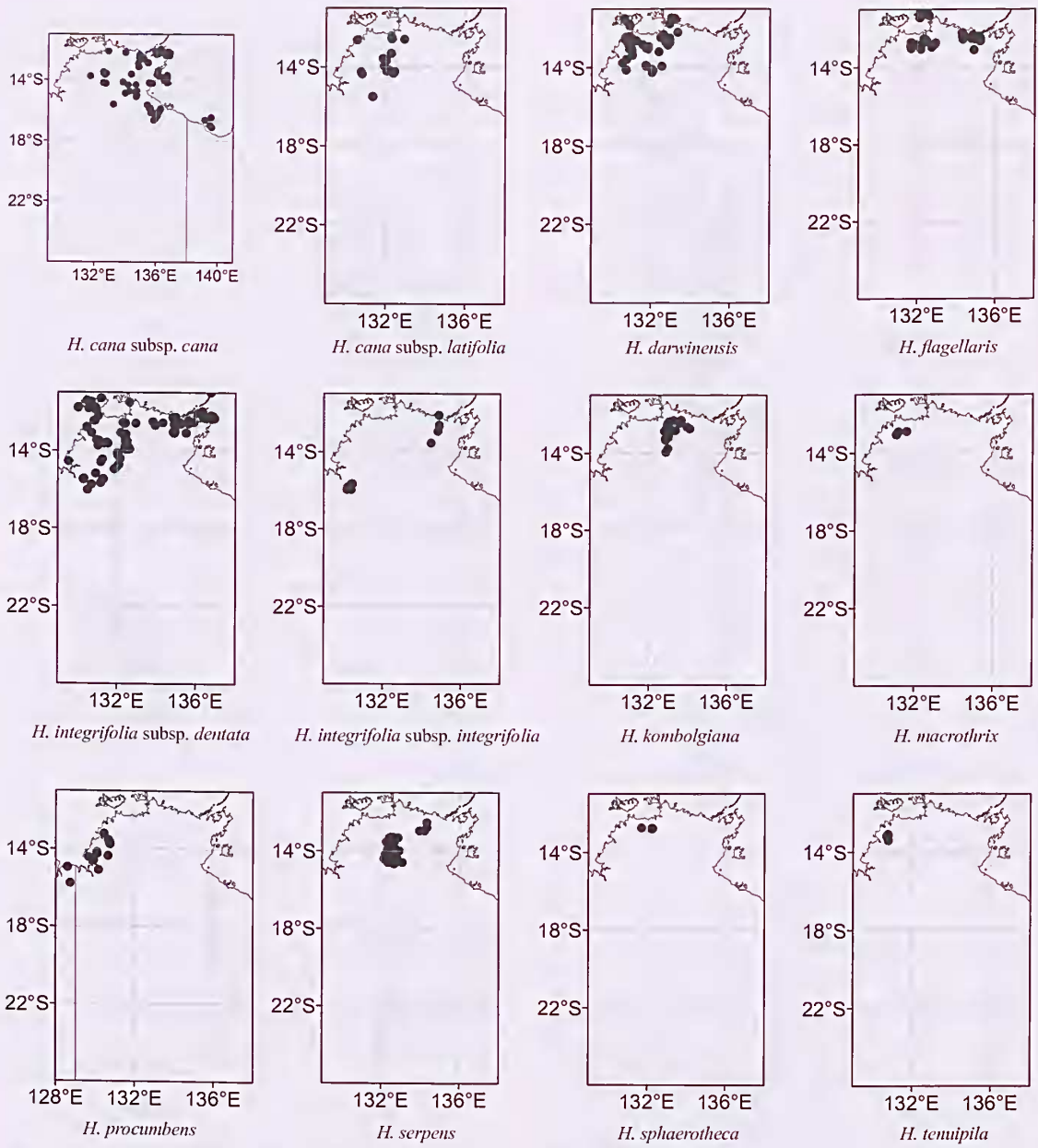

Fig. 4. Distribution of *Helicteres* species in the N.T. and adjaeent parts of W.A. and Qld.

of Oenpelli, Mt Borradaile road, 23 June 1992, *I.D. Cowie 3022 & R. Booth* (BRI, DNA, MEL); Biekerton Is., near airport, 29 April 1993, *I.D. Cowie 3903 & C.R. Dunlop* (BRI, CANB, DNA, MEL); Blue Mud Bay, Woodah Is., 1 May 1993, *I.D. Cowie 4011 & C.R. Dunlop* (DNA); Rorruwuy Outstation, Arnhem Bay, 31 August 1995, *I.D. Cowie 6068* (DNA); Flinders Peninsula, E side opposite S end of Probable Is., 28 April 1996, *I.D. Cowie 6695 & P. Bokarra* (BRI, DNA); Inglis Is., north side, 30 April 1996, *I.D. Cowie 6828* (DNA); eastern Arnhem Land, near Mirrnatja, 16 June 1999, *I.D. Cowie 8348* (DNA); central Arnhem Land, near Emu Springs, 18 September 1999, *I.D. Cowie 8405* (DNA, MEL); Groote Eylandt, *c.* 18 km NE of Angurugu, 7 March 2005, *I.D. Cowie 10530 & K. Brennan* (BRI, DNA, L, MEL); *c.* 14 km SE of Nhulunbuy, on road to airport, 25 November 2007, *I.D. Cowie 11800* (DNA); cultivated at Lucy Ct, Driver (provenance Nhulunbuy area), 7 June 2010, *I.D. Cowie 12542* (DNA, SING); McArthur

River area, 12 February 1976, *L. Craven 3861* (CANB); McArthur River area, 2 June 1976, *L. Craven 4042* (CANB, DNA); 10 miles [16 km] SSW of Borroloola, 5 June 1971, *C.R. Dunlop 2218* (DNA); Rose River, 3 km W of Policeman Crossing, 1 December 1987, *C.R. Dunlop 7405* (DNA); Donydji, Arnhem Land, 20 June 1989, *C.R. Dunlop 8495 & N.G. White* (BRI, CANB, DNA, MEL, MO, NSW); Kakadu N.P., Coronation Hill, 18 June 1990, *C.R. Dunlop 8638 & B. Wilson* (DNA); Donydji; Arnhem Land, 24 June 1990, *C.R. Dunlop 8667 & N.G. White* (DNA, MEL); 55 km from Cape Crawford, 17 April 1993, *J. Egan 2083* (DNA, NSW); Roper Hwy, 7 September 1993, *J. Egan 2617 & G.J. Leach* (DNA); road to Nhulunbuy, 9 September 1993, *J. Egan 2648 & G.J. Leach* (AD, DNA); Tawallah Ranges, Limmen, 24 May 1996, *J. Egan 5363 & C.R. Michell* (DNA); 4 km W of Nhulunbuy, 18 November 1989, *P. Forster 5958* (BRI, DNA); 67 km NE of Cape Crawford, on road to Borroloola, 23 June 1991, *D. Halford 569* (BRI, DNA); Batten River crossing, Borroloola to Bing Bong road, 21 May 1984, *D. Halford 845110* (DNA); 7 km S of Gove-Ramingining road, Arnhem Land, 20 October 1981, *T. Henshall 3881* (DNA); 10 miles NNE McArthur River Station, 6 September 1911, *G. Hill 562* (MEL); Nhulunbuy, 28 April 1982, *R.C. Hinz 106* (DNA, NT); 40 km SSE Nathan River homestead, 18 January 1989, *P. Latz 11168* (MEL, PERTH, NT); c.15 miles SW of El Sharana Mine, 26 February 1973, *M. Lazarides 7875* (CANB, DNA, PERTH); track to Koolpin Gorge, 1 May 1994, *G.J. Leach 4251* (BRI, DNA); Arafura Swamp area, S of Dog Mountain, 15 September 1998, *C.P. Mangion 639 & I.D. Cowie* (DNA); eastern Arnhem Land, Gulf of Carpentaria, outstation, 14 February 1998, *C.P. Mangion 889* (DNA, LD); Cananbirini Park, 26 February 1998, *C.R. Michell 1374 & R. Carrow* (DNA); Nitmiluk N.P., 4 April 2001, *C.R. Michell 3298 & S. Boyce* (DNA, PERTH); Nitmiluk N.P., 12 March 2002, *C.R. Michell 3617* (DNA, MO, SING); 40m SW of Goyder River crossing, 16 June 1972, *J. Must 1010* (CANB, DNA, NT); 8 km ENE of Urapunga Station homestead, 10 April 1989, *T. Orr 268* (DNA); *c.* 36 km from Borroloola, road to Daly Waters, 18 May 1974, *R. Pullen 9304* (CANB, DNA); Djapididjapin, *c.* 12 km from Nangalala, 15 January 1973, *H. Reeves 588* (CANB); SW of Boroloola jump-up, 18 February 1976, *B. Rice 2240* (CANB); Nitmiluk N.P., site 451, 5 April 2001, *J.A. Risler 1300 & M. Waetke* (DNA); Nitmiluk N.P., site 453, 5 April 2001, *J.A. Risler 1301 & M. Waetke* (DNA); Mt McMinn Station, Roper Hwy, S of Roper Hwy near Big River Station turn-off, 26 April 2002, *J.A. Risler 1850 & A. Fisher* (B, BRI, DNA, NT, SING); Big River Station, 18 March 2003, *J.A. Risler 2279* (DNA); Groote Eylandt, approx. 24 km NE of Angurugu, 7 March 2005, *J.A. Risler 2840* (DNA); Groote Eylandt, 8 km SW of Umbakumba, 15 July 1987, *J. Russell-Smith 2778 & D. Lucas* (DNA); 3 km NW of Numbulwar, 1 September 1987, *J. Russell-Smith 3089 & D. Lucas* (DNA); 5 km W of Policeman Crossing, Rose River, 1 December 1987, *J. Russell-Smith 4309 & D. Lucas* (BRI, DNA); Doyndji, E Central Arnhem Land, 15 February 1974, *N.H. Scarlett 34* (DNA); beside Annie Ck, 12 July 1975, *N.H. Scarlett 51* (DNA); North Australia, *R.D. Schomburgk s.n.* (AD); near Roper River, 9 September 1867, *F. Schultz* (MEL); Limmen N.P., 50 km SE of Ranger Station along road to Lorella Springs, 19 April 2008, *P.S. Short 5587 & E.M. Johnston* (DNA); Nhulunbuy, 22 October 1986, *N.M. Smith 204* (DNA); Groote Eylandt, Hempel Bay, 30 April 1948, *R.L. Specht 329* (AD); Gove, 22 August 1948, *R.L. Specht 947* (AD); Canopy Rock, Mtn Valley station, 25 February 1963, *R.F. Swinbourne 688* (DNA); Groote Eylandt, Eminbinungwa, 17 March 1979, *J. Waddy 755* (CANB); Limmen N.P., upper Mountain Ck area, *c.* 5.8 km SSE of Gibb Bluff, 21 April 2009, *J. Westaway 2927* (DNA, LD); Nathan River Station, 5 June 1986, *G.M. Wightman 2959* (DNA); 3 km SE of Ramingining, 19 June 1987, *G.M. Wightman 3871 & N. Smith* (DNA); 30 km N of Ngukurr, Arnhem Land, 25 November 1987, *G.M. Wightman 4057* (DNA); Nhulunbuy, 21 February 1988, *G.M. Wightman 4254* (BRI, CANB, DNA); Nhulunbuy, 22 February 1988, *G.M. Wightman 4282* (DNA); Bartalumba Bay road, Groote Eylandt, 12 July 1988, *G.M. Wightman 4501* (DNA); Emerald River, Groote Eylandt, 6 October 1988, *G.M. Wightman 4618* (DNA); Limmen N.P., St Vidgeon's block, 20 April 2009, *B. Wirf 414* (DNA).

QUEENSLAND. Mornington Is., 6 November 1979, *J. Clarkson 2691* (BRI, DNA, K, MO); Bentinck Is., 14 May 1997, *D.J. Liddle s.n.* (BRI, DNA); Sweers Is., E end of air strip, 16 November 2002, *L. Pedley SWI74* (BRI, DNA); SE corner Bentinck Is., 29 May 1963, *N.B. Tindale s.n. & P. Aitken* (AD – 3 sheets, BRI); Mornington Is., 31 May 1963, *N.B. Tindale s.n.* (AD).

Description. Calyx and capsule densely and shortly stellate-puberulous or densely pilose with stellate hairs and straight or flexuose bristles. Stipules caducous, linear, 2.5–12 mm long. Petiole 3–13 mm long. Leaf lamina lanceolate to ovate, less often linear, narrowly oblong, 37–150 mm long, 7–40 mm wide, 2–11 times longer than wide, more or less discolorous, main lateral veins at base extending 32–50% of leaf length, margin usually entire, rarely toothed in the upper half, apex acute to obtuse. Calyx 6–10 mm long. Petals 10–14 mm long. Androgynophore 7.5–12 mm long. Capsule 7–20 mm long. Flowers and fruits: most months.

Distribution and ecology. Widespread in the eastern part of the Top End, extending from Kakadu N.P. and Gove Peninsula around the Gulf hinterland into the Qld Gulf country.

Helicteres cana subsp. *latifolia* Cowie, subsp. nov.

(Figs 3C, 4 ,5)

A *Helicteres cana* Schott & Endl. subsp. *cana* lamina folii non valde canieulata vel longistrorsum plicata, latiore et ovata vel elliptica ad suborbiculare vel latissime ovata, 1–1.3-plo longiore quam latiore, venis magnis basis pro parte maxima ultra 50% lamina extensis, margine plus

minusve serrato dimidio supero ad capsula longioribus (14–32 mm longa) differens.

Type: Australia, N.T., Gregory N.P.; near entrance, off Victoria Hwy, 10 February 1992, *I.D. Cowie 2209 & P.S. Brocklehurst* (HOLOTYPE: DNA; ISOTYPES: AD, BRI, CANB, K, MEL, NSW, PERTH).

Other specimens examined. NORTHERN TERRITORY. Jarrome Yards, 10 May 1994, *M. Barritt 1208* (DNA); Kapalga, SW of mining hut, 21 December 1991, *K.G. Brennan 1718* (DNA); Kakadu Hwy, 0.3 km N of turnoff to Goodparla, 22 December 1991, *K.G. Brennan 1720* (DNA); Edith Falls, 13 June 1985, *J. Brock 87* (DNA); 18 miles [29 km] E Pine Creek, 28 January 1969, *N.B. Byrnes 1345* (DNA); Kapalga, 13 December 1988, *I.D. Cowie 718* (DNA); near Mining Hut, Kapalga, 15 February 1990, *I.D. Cowie 976 & J.A. Estbergs* (DNA); Big Nellie Ck, 7 December 1990, *I.D. Cowie 1449 & C.R. Dunlop* (DNA); near Raft Point, *c.* 22 km from Mandorah turn-off, 1 February 1991, *I.D. Cowie 1490 & C.R. Dunlop* (DNA); Nitmiluk N.P., near Edith Falls, 23 November 2001, *I.D. Cowie 9511 & G.M. Holland* (DNA); Kapalga, road to mining hut, 16 August 1991, *J. Cusack s.n.* (DNA); Edith Falls, 13 April 1995, *J. Egan 4724* (DNA); 18 miles [29 km] NE of Pine Creek township, 11 March 1965, *M. Lazarides 161* (DNA); Edith River area, 4 February 1999, *C.R. Michell 2370 & J.A. Risler* (DNA); Nitmiluk N.P., 1 March 2001, *C.R. Michell 3297 & S. Boyce,* (DNA); Edith Falls area, 7 May 2002, *C.R. Michell 3615* (DNA); Frances Ck mine, 23 May 2000, *D. Napier 57* (DNA); Nitmiluk N.P., site 472, 6 April 2001, *J.A. Risler 1302 & M. Waetke* (DNA); 5 km E of Winwuyurr Ck crossing, 6 February 1984, *J. Russell-Smith 1106* (DNA); Victoria River, Gregory N.P., 25 February 1986, *G.M. Wightman 2753* (DNA).

Description. Calyx and capsule hoary, densely and shortly stellate-puberulous with hairs 0.1–0.4 mm diam. Stipules caducous, linear, 2.2–5 mm long. Petiole 3–10 mm long. Leaf lamina ovate to suborbicular, very broadly ovate or very broadly obovate, rarely lanceolate, 42–105 mm long, 17–88 mm wide, 1–3.1 times longer than wide, discolorous, main lateral veins at base extending 46–87% of the length of the lamina, the lamina often irregularly dentate, serrate or sinuate in the upper half, apex acute or acuminate to rounded. Calyx 7–11 mm long; lobes 1–3 mm long. Petals 11–20 mm long. Androgynophore 12–14 mm long. Capsule 14–32 mm long. Flowers: (Aug.) Nov–Feb Fruits: Feb.–June.

Distribution and ecology. This subspecies is endemic to the western Top End of the N.T., from the lowlands of Kakadu N.P. and the western margins of Nitmiluk N.P. to Bynoe Harbour and south to Gregory N.P. It grows in woodland dominated by species such as *Eucalyptus tectifica*, *E. miniata*, *E. patellaris* and *E. phoenicea*, often with perennial grasses on coarse sandy to clay loam soils on granite, sandstone, basalt and laterite and in various topographic situations.

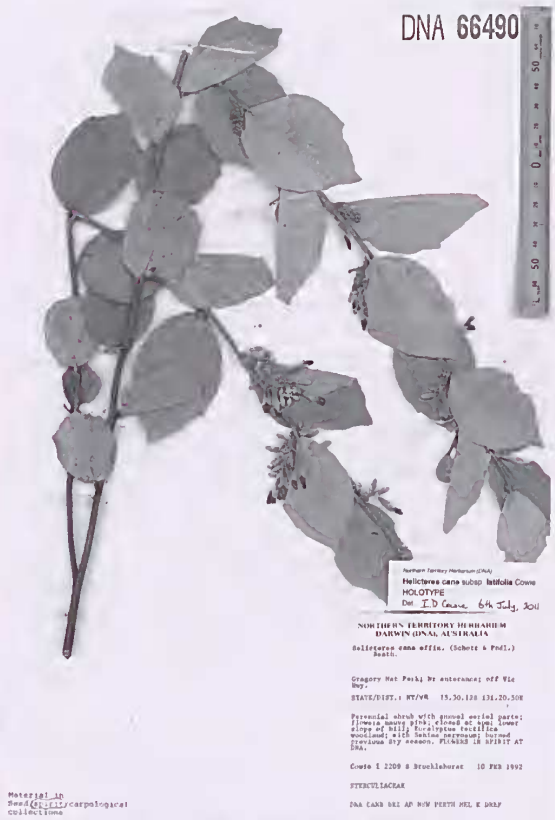

Fig. 5. Holotype of *Helicteres cana* subsp. *latifolia*.

Notes. Collections from near Pine Creek and the western side of Nitmiluk N.P. have narrower leaves and are closer to subsp. *cana* than those from elsewhere.

The isotype specimens were unfortunately dispersed before examination for preparation of this description and without *determinavit* slips indicating their type status.

Etymology. From the Latin *latus*, broad and *-folius*, leaved, referring to the broad leaves of this subspecies.

Helicteres darwinensis Cowie, sp. nov.

(Figs 4, 6, 7F–I, 8)

Ab *Helicteres iutegrifolia* habitu prostrato, indumento grosso, pilis stipitatis stellatis, stipulis persistentibus, longioribus, 7–20 mm longis, inflorescentiis 30–50 mm longis, bracteis, calyce, petalis et androgynophoro omnibus longioribus discrepans.

Type: Australia, N.T., Channel Island Rd, SW of Palmerston, 20 November 2008, *I.D. Cowie 12221* (HOLOTYPE: DNA; ISOTYPES: AD, B, BRI, CANB, K, L, MEL, MO, NSW, NY, PERTH).

Illustrations. Brock, *Top End Native Plants* 217 (1988 and subsequent reprints, incl. as *Native Plants of Northern Australia*), as *Helicteres* sp. (lower illustration).

Other specimens examined. NORTHERN TERRITORY. E of Fogg Bay, 13 August 1946, *S. Blake 16793* (DNA); Mandorah, track off main Darwin road, 21 December

1994, *R. Booth 234 & P.F. Munns* (DNA); Edith Falls, 10 November 1986, *D. Bowman 299* (DNA); Munmalary, 3 May 1986, *D. Bowman 367* (DNA); Kakadu N.P., below Mt Brockman massif, 1 April 1990, *K.G. Brennan 217* (DNA); Kakadu N.P., Ranger Lease, 10 December 1990, *K.G. Brennan 796* (DNA); Ranger Lease, 5 December 1991, *K.G. Brennan 1645* (DNA); Murgenella, 3 September 1986, *J. Brock 136* (DNA); Darwin River region, Labersheda, 1 October 1983, *J. Brock 149* (DNA); Darwin River Dam area, Labersheda, 28 September 1986, *J. Brock 154, 155* (DNA); Berrimah, Quarantine road, 10 March 1969, *N.B. Byrnes 1402* (DNA.); East Arm Rd, near causeway, 16 October 1986, *M.J. Clark 705* (DNA); near Marlow Lagoon, Palmerston, 14 March 1990, *I.D. Cowie 975* (DNA); near Marlow Lagoon, Palmerston, 12 June 1990, *I.D. Cowie 1315* (DNA); E of Pioneer Ck, Mandorah Road, 9 June 1990, *I.D. Cowie 1316* (DNA); Old Jim Jim road, 16.4 km from Arnhem Hwy, 8 February 1991, *I.D. Cowie 1370 & R. Booth* (DNA); Litchfield N.P., 23 November 1990, *I.D. Cowie 1425 & C.R. Dunlop* (DNA); Jabiru, below lake wall, 30 December 1991, *I.D. Cowie 2142* (DNA); *c.* 2 km N Koongarra Saddle, beside road, 1 January 1992, *I.D. Cowie 2143* (BRI, DNA); N end Koongarra Airstrip, 1 January 1992, *I.D. Cowie 2145* (DNA); N of Brogden Pt, 10 October 1992, *I.D. Cowie 3185* (DNA); Arnhem Hwy, Oenpelli turnoff, 15 October 1992, *I.D. Cowie 3249* (DNA); near Numbuwah Rock. 13 May 1997, *I.D. Cowie 7554* (DNA); Stuart Hwy, *c.* 35 km N of Katherine, 23 November 2001, *I.D. Cowie 9518 & G.M. Holland* (BRI, DNA); Daly River road, just S of Survey Ck, 3 December 2002, *I.D. Cowie 9658 & C.P. Mangion* (DNA); 10 km S. of junction Arnhem Hwy-Pine Creek road. 18 May 1980, *L. Craven 5576* (CANB, DNA); 35 km SSW Cooinda, Pine Creek road, 19 May 1980, *L. Craven 5598* (CANB, DNA); Margin of Jabiru airstrip, 22 March 1984, *L. Craven 8238 & G.M. Wightman* (DNA); 23 km S of Darwin along Stuart Hwy, 24 May 1987, *L. Craven 8589 & J.P. Grace* (CANB, DNA); 1 km W of Mt Bundey Ck, Arnhem Hwy, 14 December 1990, *C.R. Dunlop 8774 & I.D. Cowie* (DNA); Litchfield N.P., along main rd, 24 April 1993, *J. Egan 2178* (DNA); Litchfield N.P., 17 December 1993, *J. Egan 2911* (DNA); Mount Todd mine site, 17 March 1995, *J. Egan 4441* (DNA); road to Umbrawarra Gorge, 5 April 1995, *J. Egan 4645* (DNA); Kangaroo Flats-Wangi Falls road, 23 December 2004, *J. Egan 5459* (DNA); Edith Falls road, 10.5 km from Stuart Hwy, 3 December 1990, *M. Evans 3474* (DNA); Melville Is., 13 April 1986, *R. Fensham 86* (DNA); Melville Is., 3 September 1986, *R. Fensham 271* (DNA); Mandorah Road, 62 km past Berry Springs, 21 November 1989, *P. Forster 6053* (DNA); Takamprimili Ck, Pickertaramoor, Melville Is., 24 November 1989, *P. Forster 6085* (DNA); Mt Brockman, 25 October 1974, *B. Fox 701* (DNA); *c.* 12 km N of Daly River Police Stn, 22 May 1983, *P. Fryxell 4247* (CANB, DNA); Port Darwin, 26 July 1913, *G.F. Hill 97* (MEL); Port Darwin, 1883, *M. Holtze s.n.* (MEL); Port Darwin, 1883, *M. Holtze 251* (MEL); Port Darwin, 1885, *M. Holtze 545* (MEL); Port Darwin, 1888, *M. Holtze s.n.* (MEL); Port Darwin, *s.d.*, *M. Holtze s.n.* (NSW); Port Darwin, 5 March 1905, *M. Holtze 1134* (MEL); Port Darwin, 5 March 1905, *M. Holtze 1235* (MEL); *c.* 5 km from Dundee Beach turnoff, N along Cox Peninsula Road, 12 October 2001, *A.M. Hope 21 & D. Dixon* (DNA, SING); Palmerston, near junction of Lambrick Avenue/Stuart Hwy, 23 November 2001, *A.M. Hope 32* (DNA); Munmalary Stn, 15 April 1973, *P. Latz 3902* (DNA); Melville Is., on Maclear Ck road, 20 January 1992, *G.J. Leach 2942 & I.D. Cowie* (DNA); Finniss River road to Litchfield N.P., 21 September 1992, *G.J. Leach 3259* (DNA); Emerald Springs, 22 September 1992, *G.J. Leach 3264* (DNA); Jindare Station, Stray Ck catchment, Daly Basin, 13 November 2003, *D.L. Lewis 595* (DNA); Cox Peninsula, 13 April 1988, *K.M. Manning 368* (DNA); Koongarra area, *s.d.*, *O.H. Marshal s.n.* (CANB); 5 miles [8 km] NW of Humpty Doo, 8 November 1971, *J.L. McKean 25* (DNA); Darwin Harbour, Wickham Point, 14 January 1997, *K. Metcalfe s.n.* (DNA); Edith River Area, 12 April 1999, *C.R. Michell 2340 & J.A. Risler* (DNA); Nitmiluk N.P., 28 March 2002, *C.R. Michell 3616* (DNA); 12 miles [19 km] W.S.W. of Mudginberri H/st, 20 November 1970, *J. Must 582* (DNA); Acacia Gap turn-off, 39.6 miles [63.4 km] S of Darwin, 15 June 1964, *D.J. Nelson 1195* (DNA); Batchelor area, 17 December 1974, *M.O. Parker 614* (DNA); Horns Ck, 8 November 1978, *M. Rankin 1554* (DNA); Berrimah Riding School, 9 December 1982, *M. Rankin 2680* (DNA); 11 km from Stuart Hwy along Umbrawarra Gorge road, 12 January 1999, *J.A. Risler 77 & R.A. Kerrigan* (DNA); Charles Darwin N.P., 5 March 1998, *P.S. Short 4666 & C.R. Dunlop* (DNA); Elizabeth River crossing, Channel Is. road, 20 March 1989, *N.M. Smith 1424* (DNA); near Robin Falls, Mt Bundy station, 3 November 1985, *B.W. Strong 785* (DNA); Holmes Jungle, 12 km NE Darwin, 18 April 1980, *I.R.H. Telford 7432 & J. Wrigley* (CANB); 4 km ESE Jabiru, 18 April 1980, *I.R.H. Telford 7547 & J. Wrigley* (CANB); Fannie Bay, 1886, *J.E. Tenison-Woods s.n. & M. Holtze* (MEL); about halfway between Stuart Hwy & Berry Springs, 25 September 1980, *J.T. Waterhouse 9834* (NSW);

Fig. 6. *Helicteres darwinensis*. Flowers. (*I. D. Cowie 12221*).

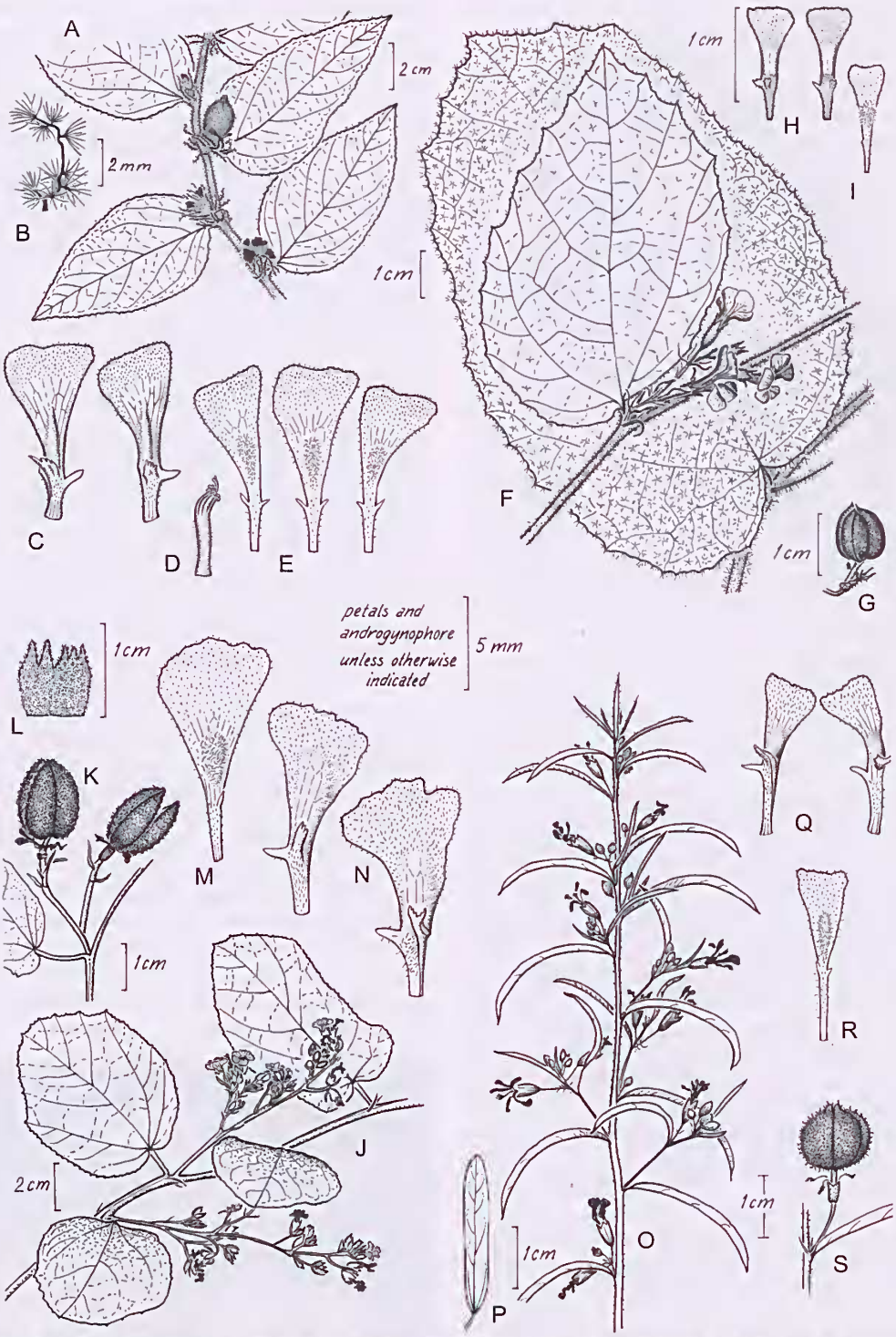

Fig. 7. A-E. *Helicteres macrothrix*. **A**, flowering branchlet; **B**, bristle from fruit (A-B, Dunlop 9805); **C**, upper petals; **D**, androgynophore; **E**, lower petals (C-E, Cowie 9656 & Kerrigan). F–I. *Helicteres darwinensis*. **F**, flowering branchlet and mature leaf (Dunlop 8774 & Cowie, Rankin 2680); **G**, fruit (Cowie 1315); **H**, upper petals; **I**, central lower petal (H–I, Cowie 12221, type). J–N. *Helicteres serpens*. **J**, flowering branchlet (Evans 3483); **K**, fruit; (Leach 4379) **L**, calyx; **M**, central lower petal; **N**, upper petals (L–N, Cowie 2139). O–S. *Helicteres sphaerotheca*. **O**, flowering branchlet; **P**, leaf; **Q**, upper petals; **R**, central lower petal (O–R, Cowie 2146, type); **S**, fruit (Dunlop 6120). Scale bars: A, J = 2 cm, F, G, H, I, K, L, O, P, S = 1 cm, C, D, E, M, N, Q, R = 5 mm, B = 2 mm

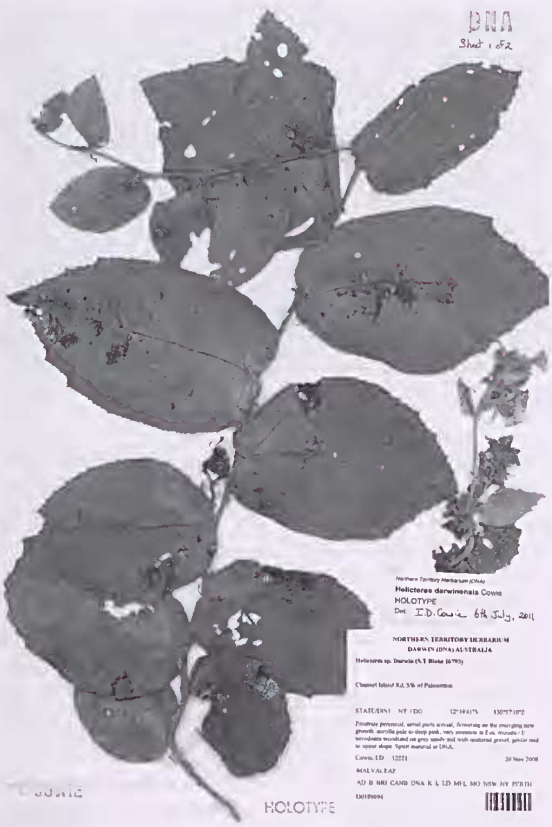

Fig. 8. Holotype of *Helicteres darwinensis*.

0.5 km W Geringbark scarp, SE corner of Jabiluka outlier, 5 December 1980, *J.T. Waterhouse 10938* (DNA, NSW); Mary River Camp, *s.d., M. White 30* (CANB); Berrimah, 7 October 1983, *G.M. Wightman 688* (DNA); Lowther Rd, 21 November 1984, *G.M. Wightman 1768* (DNA).

Description. Multi-stemmed perennial subshrub with prostrate annual above-ground stems to 0.5 m long and a woody perennial root stock. Most vegetative parts and calyx densely stellate-hirsute with sessile and stipitate (0.3 mm long) hairs. Hairs sparse to dense on upper surface of leaf lamina, the new growth with scattered digitiform glandular hairs. Stipules persistent, filiform, 7–20 mm long. Petiole 5–10 mm long. Leaf lamina usually ground-hugging, accrescent, lanceolate to ovate or orbicular, 12–180 mm long, 7–110 mm wide, usually discolorous, hairs of the upper surface 1–2.2 mm diam., on the lower surface 1.3–3.5 mm diam., base cordate, asymmetric, 5-nerved, margins irregularly serrate, apex acute to rounded. Inflorescence axillary, congested, a dichasium or panicle of dichasia, 30–50 mm long, 4–22-flowered, extra-floral nectaries present; dichasia 3-flowered; bracts 7–10 mm long, filiform; pedicels 0–5 mm long. Calyx narrowly obconical, 6–9 mm long, basal nectary incomplete, margin oblique; lobes triangular, 1–4 mm long. Corolla not or scarcely 2-lipped. Petals mauve-pink, weakly dimorphic, 12–16 mm long, claw auriculate, limb cuneate, callused near base, claw and limb with scattered to sparse, simple, septate hairs *c.* 0.15 mm long; lower 3 petals *c.* 9.5 mm wide, with 0–2 small appendages on claw, callus with matted simple septate hairs *c.* 1 mm long; upper pair, *c.* 5.5 mm wide, with 2 prominent appendages on claw, callus smooth, obscure. Androgynophore 5–7 mm long, straight, sparsely hairy, distinctly shorter than calyx; stamens 10, shortly connate at base, 0.7–1.2 mm long; anthers transverse; staminodes 5, spathulate-acute, *c.* 0.8 mm long. Style straight, *c.* 1 mm long; stigma of 5 pin-like lobes, tercte. Capsule adpressed to ground, depressed globose to obloid, 5–9 mm long, 6–7 mm diam., sparsely stellate-pilose, brown, styles caducous; carpels straight, 1–3-seeded. Seeds sub-rhomboidal, *c.* 2.5 mm long, 2 mm wide, irregularly rugose, dark brown. Flowers: Aug.–Jan. Fruits: Dec.–June.

Distribution and ecology. The species is endemic to the northern N.T. and very common in the north-western Top End, north of Pine Creek and west of the Goomadeer River, including the Tiwi Islands. It grows in *Eucalyptus* forest and woodland on lateritic soils.

Notes. *Helicteres darwinensis* differs from *H. integrifolia* by the prostrate habit, coarse indumentum with stipitate stellate hairs, longer, persistent stipules which are 7–20 mm long, inflorescence 30–50 mm long, and with the bracts, calyx, petals, and androgynophore all longer. While the new shoots are often erect at emergence, they quickly become prostrate.

This species has been referred to as *Helicteres* A78389 Darwin and *Helicteres* sp. Darwin (*S.T. Blake 16793*) on herbarium specimen labels and unpublished checklists from DNA.

Etymology. A reference to the City of Darwin, Northern Territory, around which the species is a common component of the *Eucalyptus* woodland.

Helicteres flagellaris (Benth.) Cowie, comb. et stat. nov.

(Figs 4, 9).

Helicteres dentata var. *flagellaris* Benth., *Flora australiensis* 1: 233 (1863); *H. semiglabra* var. *flagellaris* (Benth.) F.M. Bailey, *The Queensland Flora* 1: 142 (1899).

Type: Australia, N.T., Port Essington, Apr. 1840, *J. Armstrong 533* (HOLOTYPE: K, *n.v.*, photo DNA).

Other specimens examined. NORTHERN TERRITORY. Arafura Swamp, 8 June 1996, *R. Booth 1893* (DNA); along track to Black Jungle Spring, 1 January 1992, *K. Brennan 1675* (DNA); Kakadu N.P., Arnhem Hwy, 1 km W of Flying Fox Ck, 13 January 1991, *K. Brennan 841* (DNA); 1.7 km S of Danger Point, Cobourg Peninsula, 6 May 1987, *M.J. Clark 1052* (DNA); 25.1 km E of Kerr Pt, Weipa, 21 April 1991, *J. Clarkson 9013 & V.J. Neldner* (BRI, DNA, K, L, MBA, PERTH); N of Bertie Ck, 25 February 1992, *J. Clarkson 9202 & V.J. Neldner* (BRI, DNA, MBA); Kapalga, 15 December 1976, *R. Collins 175* (BRI), CANB, DNA); Kakadu N.P., Kapalga, near Red Lily turn-off, 13

December 1988, *I.D. Cowie 721* (DNA); Kakadu N.P., Arnhem Hwy, Kapalga turn-off, 11 November 1991, *I.D. Cowie 2113* (DNA, MEL); Arnhem Hwy, truck stop just W of Kakadu, 10 November 1992, *I.D. Cowie 3265 & S. Pilkington* (DNA); Port Essington, Wangewanja Cove, 13 April 1993, *I.D. Cowie 3371* (BRI, CANB, DNA, MEL); Cobourg Peninsula, Raffles Bay, 20 April 1993, *I.D. Cowie 3772* (DNA); Mary River, near Roek Hole, 6 November 1994, *I.D. Cowie 5171* (DNA); Central Arnhem Land, Emu Springs area, 17 September 1999, *I.D. Cowie 8397 & R.K. Harwood* (DNA); Arnhem Land, *c.* 44 km SSE Maningrida, 16 March 2000, *I.D. Cowie 8518* (DNA); near Ranger Station, e.13 km SSE of Maningrida, Arnhem Land, 6 April 2000, *I.D. Cowie 8767* (DNA); Arnhem Land, *c.* 22 km ESE of Ramingining, 28 June 2001, *I.D. Cowie 9462* (BRI, DNA); Arnhem Hwy, 4.4 km E of Point Stuart turnoff, 24 February 2004, *I.D. Cowie 9985* (BRI, DNA, MEL, CANB); Mary River, W side near Arnhem Hwy, 4 January 2005, *I.D. Cowie 10346* (BRI, CANB, DNA); *c.* 40 km W of Jabiru, 18 Mareh 1981, L. *Craven 7853* (CANB, DNA); Kapalga, 23 February 1981, *J. Cusack 110* (DNA); Croker Is. (northern), 28 November 2001, *D. Dixon 952 & B. Baker* (DNA); Koongarra Area, 24 April 1980, *C.R. Dunlop 5516* (BRI, CANB, DNA, MEL); Kakadu N.P., Kapalga, 12 Mareh 1982, *C.R. Dunlop 6118* (BRI, DNA); Kapalga, 8 Deeember 1992, *J. Egan 394* (DNA); Kakadu N.P.; Kapalga, 10 January 1993, *J. Egan 859* (CANB, DNA); Kakadu N.P., Kapalga, 7 February 1993, *J. Egan 1445* (DNA); Cobourg Peninsula, Reeord Pt, 11 April 1993, *J. Egan 1996* (CANB, DNA); Cobourg Peninsula, Kangaroo Pt, 11 April 1993, *J. Egan 2008* (CANB, DNA); Kapalga, 16 August 1993, *J. Egan 2529* (DNA); Kapalga, Kakadu N.P., 25 January 1994, *J. Egan 3052* (DNA); Black Point, Ranger Stn, Cobourg Peninsula Wildlife Sanetuary, 23 May 1983, *P. Fryxell 4256* (CANB, DNA); 16m SSE of Nourlangie Safari Camp, 27 February 1973, *M. Lazarides 7884* (CANB, DNA); Arnhem Land, about 2 km NW of Dog Mountain, 12 September 1998, *C.P. Mangion 609 & I.D. Cowie* (DNA); Mckinlay River Station, 24 August 2001, *D. Napier 63* (DNA); Cobourg Peninsula, S of Stewart Point, 15 March 2002, *J.A. Risler 1893 & R. Firth* (DNA); Arnhem Land, 16 km N of Mirrngatja, 4 November 1987, *J. Russell-Smith 3969, D. Lucas* (DNA); Kakadu N.P., Kapalga, 18 January 1995, *J. Russell-Smith 9218* (DNA); Murwangi, 10 September 1998, *P.S. Short 4807 & C.R. Dunlop* (DNA); 15 km from Koongarra Saddle along traek to Jabiru, 24 April 1980, *I.R.H. Telford 8154 & J. Wrigley* (CANB); Kakadu N.P., near Nanguluwurr roek art site, 13 November 2010, *J. Westaway 3384* (DNA, MO); Flying Fox Ck, Arnhem Hwy, 9 January 1986, *G.M. Wightman 2516* (DNA); Cobourg Peninsula, Gamaragi area, 27 June 1995, *G.M. Wightman 6235 & D.M. Jackson* (DNA).

Description. A subshrub with prostrate annual aboveground stems to 0.5 m long and a woody perennial tap root. Most parts with a sparse to very dense indumentum of sessile, stellate hairs 0.2–0.4 mm diam. Stipules persistent, subulate, 4–5.5 mm long. Petiole 1.5–5 mm long. Leaf lamina diseolorous to strongly diseolorous, ovate to suborbieular, 1.8–6.5 em long, 1.1–5.1 em wide, 1–1.5 times longer than wide, upper surfaee usually glabrous or with simple hairs, lower surface often hoary, base eordate, rarely rounded, 5–7-nerved, margin irregularly dentate or serrate throughout, apex rounded to aeute, often shortly apiculate. Inflorescenee an interrupted axillary eyme, 30–140 mm long, with 1–6 flowers; braets subulate, rarely leafy, 3–4 mm long; extrafloral neetaries present, dark red; pedicels 0–4 mm long. Calyx 4.5–9 mm long, tube 4–5 mm long, lobes 1.5–5 mm long. Corolla scarcely 2-lipped. Petals mauve, slightly dimorphie, slightly bilabiate, 10–16 mm long, long elawed; limb broadly euncate to depressed obovate, eallused near base, both surfaees with a sparse indumentum of ereet to appressed short septate hairs *c.* 0.1 mm long; lower 3 petals with 1or 2 small appendages on margins of elaw; eallus woolly hairy; upper 2 with 2 prominent appendages on elaw, eallus smooth, shiny, glabrous. Androgynophore 4.5–6 mm long; androeeium and gynoeeium oblique; stamens *c.* 0.8 mm long. Style 1–1.5 mm long; stigma of 5 pin-like lobes, terete. Capsule ellipsoid to globose, 8–12 mm long. Seeds 1–3 per locule; shape variable, irregularly rugose, dark brown. Flowering & Fruiting: Nov.–June.

Fig. 9. *Helicteres flagellaris*. Flower and leaf bases. (*I. D. Cowie 10346*).

Distribution and ecology. Common in the northern N.T. from the Mary River, Kakadu N.P., and Cobourg Peninsula to Ramingining, but in the Darwin Region known only from east of the Mary River. Grows in *Eucalyptus* woodland mostly on sandy or silty soils.

Notes. As aeeepted here, there is some variation in the indumentum of this speeies. Broadly, speeimens fall into those with eoarse, stipitate stellate hairs (0.5) 1.0–1.5 mm in diam. Growing on sites with finer textured soils and those with finer, sessile stellate hairs 0.1–0.3 (0.6) mm diam. and growing on sandy soils. Within the large hair group some speeimens have ealyx lobes longer than the tube (*Short 4807 & Dunlop; Cowie 8397 & Harwood*), and in *Cowie 8767* the lobes are also almost glabrous (rather than densely hairy)

on the abaxial surface. Several specimens from the Mary River area (*Cowie 5171, 10346; Napier 63)* have lanceolate to oblanceolate or very broadly elliptic floral bracts, with long stipitate stellate hairs along their margins.

Further examination of material from Queensland is required. A number of specimens e.g. *L.J. Brass 19587, J. Clarkson 10028 & V.J. Neldner* appear to be closely related and may be referrable to this taxon.

The species differs from *H. integrifolia* by the prostrate habit, persistent stipules 4–5.5 mm long, leaves typically ovate to suborbicular, the upper leaf surface glabrous or with simple hairs, the cymes 30–140 mm long, petals 10–16 mm long and the longer androgynophore.

Helicteres flagellaris has also been referred to as "*Helicteres* D47082 prostrata" on herbarium specimen labels and unpublished checklists lists from DNA.

***Helicteres integrifolia* (F.Muell.) Cowie, comb. nov.**

(Fig. 4).

Methorium integrifolium F.Muell., *Transactions of the Philosophical Institute of Victoria* 3: 40 (1859).

Type citation: "On rocky declivities of the sandstone tableland of the Upper Victoria River". **Type details:** Australia, N. T., upper Victoria River, January 1856, *F. Mueller s.n.* (Holotype: MEL (MEL222173); Isotype: K, *n.v.*, photo DNA).

Helicteres cana auct non. (Schott & Endl.) Benth., Benth., *Flora australiensis* 1: 232 (1863).

Description. Erect to spreading, multi-stemmed subshrub to 0.5 m, with annual above-ground parts and a woody perennial root stock. Most vegetative parts and calyx with moderately dense to very dense sessile stellate hairs 0.1 to 0.6 (–1.2) mm diam., hairs sessile or sometimes shortly stipitate; new growth with scattered red minute glandular hairs. Stipules caducous, subulate, 1.5–6 mm long. Petiole 3–15 mm long. Leaf lamina ovate to elliptic to suborbicular, less often lanceolate, oblong-oblanceolate, or oblanceolate to obovate, 18–115 mm long, 8–50 (–75) mm wide, 1.1–3.2 times longer than wide, scarcely to strongly discolorous, under surface usually hoary or grey-green when young becoming less so with age, upper surface with sparse to dense stellate hairs, green to grey, base cordate to rounded or cuneate, symmetric to sometimes asymmetric, 3-nerved for 1/3 to 3/4 of length, margins entire near base, usually becoming serrate near apex, apex acute to rounded. Inflorescence axillary, cymose, to 35 mm long, with few-many dichasia, dichasia 2- or 3-flowered; extra-floral nectaries present; bracts 1–4 mm long, subulate; pedicels 0–6 mm long. Calyx tubular to narrowly obconical-campanulate, 3–6 mm long; basal nectary short, incomplete, margin truncate; lobes triangular, 0.5–2 mm long. Corolla weakly 2-lipped or not. Petals mauve-pink, slightly dimorphic, 5–10 mm long, long clawed, limb cuneate, with sparse, minute, erect, glandular hairs, slightly callused near base, apex truncate to obliquely truncate, irregular; lower 3 slightly longer than upper pair, claw with 1–2 small appendages, callus woolly hairy; upper pair with 2 prominent appendages on claw, callus smooth shiny glabrous, claw with sparse longer simple septate hairs. Androgynophore 2.5–4.5 mm long, straight, with scattered minute hairs on adaxial side, shorter than or equal to calyx; stamens 10, shortly connate at base, 0.8–1 mm long; anthers transverse; staminodes 5, oblanceolate to spathulate-acute, *c.* 0.7–1 mm long. Style 1–1.2 mm long; stigma of 5 pin-like lobes, terete, caducous. Capsule ovoid to ellipsoid or globular, 8–19 mm long, 6–14 mm diam., with a mid-dense covering of sessile stellate hairs, stellate-hairy bristles absent or present and then sub-dense or dense, floccose, 1.5–4 mm long; carpels straight, 1–4-seeded. Seeds variously shaped, ellipsoid to conoidal or sub-rhomboidal, often laterally compressed, 1.8–3.8 mm long, 1.7–2.5 mm wide, irregularly rugose, dark brown. Flowers: Sept.–Feb. Fruits: Feb.–June.

Notes. Bentham (1863) reduced *Methorium integrifolium* F.Muell. to synonymy under *H. cana*. While the leaves of the type of *M. integrifolium* have almost entire margins and a similar greyish colour and indumentum to *H. cana*, I believe that the species currently known as *M. integrifolium* must be reinstated and transferred, as above, to the genus *Helicteres*. The type specimen of *M. integrifolium* has a calyx 4–5 mm long, the petals are *c.* 7 mm long, the lower petals have a patch of long, matted, glandular hairs and the androgynophore is 3.5–4 mm long. In contrast, *H. cana* has a calyx 7–11 mm long, the petals 11–20 mm long, the lower ones lack a patch of long matted hairs and the androgynophore is 7.5–14 mm long. These character differences are maintained in populations of *H. cana* which are sympatric with *M. integrifolium*

Further investigation shows that *H. integrifolia* and *H. dentata* form part of a complex varying in leaf width, discolorousness, density of indumentum on the leaf surfaces, length of bristles on the fruit and degree of serration of the leaf margin. Variation appears to be partly related to edaphic factors and partly clinal.

I here recognise two subspecies within *H. integrifolia*, i.e. subsp. *integrifolia* and subsp. *dentata*. However, there are some specimens which do not comfortably fit within either subspecies and for the time being are simply referred by me to *H. integrifolia*. Thus, a series of collections from southeast Arnhem Land and adjacent Limmen N.P. (*Cowie 12368, 12382, Lewis 1008, 1018, Manning 425, Wilson 1285*) have relatively small concolorous but bifacial leaves, a coarse open indumentum of hairs 0.5–1.2 mm diam., are almost devoid of short glandular hairs on the new growth and have densely long-bristled fruit. Flowers have not been seen. These may prove to represent a distinct taxon allied to *H. integrifolia, H. sphaerotheca* and *H. tenuipila* and the variation exhibited by them is not included in the description above. Similarly, the specimens *Brennan 1994, 270* and *Cowie 8565* may represent an additional undescribed taxon. They are distinctive in having entire or few-toothed, lanceolate, concolorous leaves, a short, close indumentum and fruit with bristles to 0.5 mm long, although the flower

size is consistent with *H. integrifolia*, *H. angustifolia*, *H. sphaerotheca* and *H. tenuipila*. These characters and the small flowers are also consistent with specimens of the southeast Asian *H. lanceolata* (Tang *et al.* 2007). A number of collections from the Douglas Springs area, which lack flowers, are also tentatively referred to this species pending further collections from that area.

Both subspecies maintain their low, multi-stemmed growth habit in cultivation, regenerating each wet season from a perennial, woody rootstock, even when protected from fire.

1 Leaf lamina slightly discolorous, upper surface densely hairy; capsule densely covered with floccose, stellate-hairy bristles 1–4 mm long ....subsp. *integrifolia*

1: Leaf lamina strongly discolorous especially when young, upper surface with sparse to scattered hairs; capsule lacking stellate-hairy bristles or bristles scattered, rarely to 2 mm long .....subsp. *dentata*

Helicteres integrifolia (F.Muell.) Cowie subsp. *integrifolia*

Other specimens examined. NORTHERN TERRITORY. Gregory N.P., Newcastle Ranges Sinkhole, 15 April 1996, *R. Booth 1624* (DNA, MEL); Timber Creek Lookout Area, 27 January 2011, *K. Brennan 9018* (DNA); Bullita, 24 August 1991, *P.S. Brocklehurst 562* (DNA); S of Ramingining, 22 May 1990, *I.D. Cowie 1313* (CANB, DNA, MEL, PERTH); 18 Widdup Cres., Driver, 21 January 1992, *I.D. Cowie 2147* (DNA); Gregory N.P., Bullita station, 13 February 1992, *I.D. Cowie 2322 & P.S. Brocklehurst* (BRI, DNA, MEL); Gregory N.P., W of Timber Creek, 15 February 1992, *I.D. Cowie 2427 & P.S. Brocklehurst* (BRI, DNA); just W of Timber Creek, lookout area, 18 May 1997, *I.D. Cowie 7574* (CANB, DNA); S of Ramingining, 11 December 1998, *I.D. Cowie 8145 & R.K. Harwood* (BRI, CANB, DNA, MEL, NSW, NY); near SW side of Arafura Swamp, Central Arnhem Land, 11 June 2000, *I.D. Cowie 8913 & C.R. Dunlop* (DNA); just W of Timber Creek, lookout area, 21 November 2001, *I.D. Cowie 9395 & G.M. Holland* (BRI, DNA); just W of Timber Creek lookout area overlooking town, 21 November 2001, *I.D. Cowie 9500 & G.M. Holland* (BRI, CANB, DNA, K, MEL, MO); 25 km E of Bulman, 23 June 1990, *C.R. Dunlop 8650 & N.G. White* (BRI, DNA); Gregory N.P., side gorge, plateau approx. 29 km NW of Bullita outstation. 300 m from head of sandstone, 15 April 1996, *M. Duretto 1008 & C. Coles* (DNA, MEL); Timber Creek, road to Searp, V.R.D, 11 April 1990, *M. Evans 3120* (DNA, K); Gregory N.P., *c.* 20 km N of Bullita Ranger Station, 15 April 1995, *W. Gaskon 10 & D.B. Foreman* (DNA); E of East Baines River, 10 March 1989, *G.J. Leach 2402 & C.R. Dunlop* (CANB, DNA); Gregory N.P., 10 March 1998, *C.R. Michell 1145* (DNA); Gregory N.P., fire plot 22, 20 May 1999, *C.R. Michell 2441 & A.H. Johnson* (DNA); VRD, headwaters of Big Horse Ck, 12 March 1989, *J. Russell-Smith 7776* (DNA); Gregory N.P., headwater of unnamed tributary of East Baines River, *c.* 46 km SW of Timber Creek, 15 April 1996, *N. Walsh 4359 & G. Jones* (DNA, MEL); Milingimbi, Arnhem Land, 16 March 1987, *G.M. Wightman 3410 & N.M. Smith* (DNA).

Description. Leaf lamina often grey-green, slightly discolorous, the upper surface densely hairy. Capsule 11–14 mm diam., densely covered with floccose, stellate-hairy bristles 1–4 mm long. Flowers: Nov. Fruits: Feb.–June.

Distribution and ecology. This subspecies is endemic to the northern N.T. and grows in *Eucalyptus* woodland on sandy soils.

Notes. Specimens of subsp. *integrifolia* with almost concolorous leaves can look superficially similar to *H. cana* subsp. *latifolia*, but subsp. *integrifolia* has a shorter androgynophore, calyx and corolla and the lacks long, matted, glandular hairs on the lower petals.

This subspecies has been referred to as "*Helicteres* D29330 multicaulis" and "*Helicteres* sp. many stems (*G.M. Wightman 3410*)" on herbarium specimen labels and unpublished checklists lists from DNA.

Helicteres integrifolia subsp. *dentata* (F.Muell. ex Benth) Cowie, comb. et stat. nov.

(Figs 4, 10)

Helicteres dentata F.Muell. ex Benth. *Flora australiensis* 1: 232 (1863); *Helicteres dentata* var. *dentatata*, Benth., *Flora australiensis* 1: 233; *Methorium dentatum* (F.Muell. ex Benth.) F.Muell., *Systematic Census of Australian Plants* 15 (1882). **Type details**: Australia, Northern Territory, Upper Victoria River, October 1855, *F. Mueller*; (HOLOTYPE: K, *n.v.*, photo DNA; possible ISOTYPE: MEL (MEL222177)).

Other specimens examined. NORTHERN TERRITORY. King River, W of Katherine, 15 November 1995, *M. Barritt 2042* (BRI, DNA, MEL); Daly River Rd, adjacent to Adelaide River crossing, 16 February 1996, *R. Booth 1464 & I.D. Cowie* (BRI, DNA, MEL); Kakadu N.P., rocky hills just north of Barramundi Gorge turn-off on Kakadu Hwy, 15 May 1991, *K. Brennan 1374* (DNA); Kakadu Hwy, 1.6 km N of Barramundi Ck, 22 November 1991, *K. Brennan 1620* (DNA); 1.5 km SE Fisher airstrip, 12 December 1991, *K. Brennan 1679* (DNA); Kapalga; E slope of hill, 21 December 1991, K. Brennan *1716* (DNA); Kakadu N.P., on track to Barramundi Gorge, c.200 from Kakadu Hwy turn-off, 13 January 1992, *K. Brennan 1777* (DNA); English Company Islands, island just SW of Bosanquet Is., 6 September 1996, *K. Brennan 3311* (DNA); Cobourg Peninsula, 9 April 2006, *K. Brennan 7116* (DNA); Kakadu N.P., Old Darwin road, 6 November 2008, *K. Brennan 7876* (DNA); Melville Bay, 16 February 1803, R. Brown s.n. (BM, CANB); North Coast, R. Brown (DBN, MEL, NSW); Melville Is., Pencil road, 24 June 1987, *M.J. Clark 1236* (DNA); Kapalga, 27 April 1977, *R. Collins 382* (CANB, DNA, K); Gove Peninsula, Arnhem Land, *J.F. Cooper s.n.* (NSW); 1 km past Adelaide River, Daly River Rd, 9 November 1990, *I.D. Cowie 1400 & C.R. Dunlop* (BRI, CANB, DNA, MEL, PERTH); Melville Is., road to Paru,

Fig. 10. *Helicteres integrifolia* subsp. *dentata*. Flower and leaves. (*I. D. Cowie 11801*).

1.5 km below jump-up, 21 January 1992, *I.D. Cowie 2179 & G.J. Leach* (BRI, CANB, DNA, MEL); Melville Is., Pickertaramoor, 21 January 1992, *I.D. Cowie 2186 & G.J. Leach* (DNA); Victoria Hwy, W of Katherine, 10 February 1992, *I.D. Cowie 2207 & P.S. Brocklehurst* (CANB, DNA, MEL); Gregory N.P., near Matt Wilson Lookout, 10 February 1992, *I.D. Cowie 2232 & P.S. Brocklehurst* (BRI, DNA, MEL); Arnhem Bay, mouth of Cato River, 25 May 1992, *I.D. Cowie 2890* (DNA, MEL); 34 km N of Katherine, Stuart Hwy, 31 December 1992, *I.D. Cowie 3273* (CANB, DNA, MEL); Melville Is., Pickertaramoor, 31 March 1994, *I.D. Cowie 4837* (CANB, DNA); Garalja Is., 30 April 1996, *I.D. Cowie 6808* (DNA); Macassan pictures, *c.* 10 km SE of Nhulunbuy, 22 May 1996, *I.D. Cowie 7018* (DNA); Nitmiluk N.P., Douglas Springs area, 22 May 2001, *I.D. Cowie 9235 & D. Dixon* (DNA); Victoria Hwy, *c.* 2 km SW of Scott Ck, 20 November 2001, *I.D. Cowie 9390 & G.M. Holland* (BRI, CANB, DNA); Victoria Hwy, Kuwang Lookout, *c.* 30 km E of Timber Creek, 21 November 2001, *I.D. Cowie 9502 & G.M. Holland* (BRI, CANB, DNA, MO); Menngen (Innesvale) Station, 22 November 2001, *I.D. Cowie 9505 & G.M. Holland* (DNA, MEL, NSW); Gregory N.P., near Matt Wilson Lookout, 22 November 2001, *I.D. Cowie 9507 & G.M. Holland* (B, BRI, DNA, MEL, MO); Yinberrie Hills, N of Edith River, 23 November 2001, *I.D. Cowie 9514 & G.M. Holland* (B, BRI, CANB DNA, MEL, MO, NSW); Yinberrie Hills, N of Edith River, 23 November 2001, *I.D. Cowie 9516 & G.M. Holland* (DNA, MEL); Gunn Point area: 6.2 km SE of Gunn Point, 5 December 2003, *I.D. Cowie 9975 & R.K. Harwood* (BRI, CANB, DNA, MO); Bradshaw Field Training Area, *c.* 70 km NE of Timber Ck, near fire plot 2, 30 March 2007, *I.D. Cowie 11458 & B. Stuckey* (B, DNA); c.14 km SE of Nhulunbuy, on Central Arnhem road, 25 November 2007, *I.D. Cowie 11801* (BRI, DNA, MO); road to Mata Mata Outstation, *c.* 7.5 km N of Central Arnhem Road, W of Nhulunbuy, 4 December 2007, *I.D. Cowie 11840* (BRI, DNA, MEL, B); Kapalga, 2 May 1990, J. Cusack 572 (DNA); Kakadu N.P., Kapalga, top of transect G, 8 November 1991, *J. Cusack s.n.* (DNA); Mitchell Range, Arnhem Land, 1 April 1999, *C.R. Dunlop 10252 & N.G. White* (DNA); Melville Is., Poonali Beach, 18 December 1975, *C.R. Dunlop 3996* (DNA, NT); Kambolgie Ck, 5 km E of, 19 April 1993, *J. Egan 2128* (DNA); Kambolgie Ck, 5 km E of, 19 April 1993, *J. Egan 2132* (DNA); Kakadu N.P., Kapalga G plot, 15 March 1994, *J. Egan 3286* (BRI, CANB, DNA); Hayes Ck, 5 April 1995, *J. Egan 4641* (BRI, DNA, MEL); Victoria Hwy, near Kuwary lookout, 12 May 1995, *J. Egan 4958* (DNA); Melville Is., 10 km SE of Milikapiti, 8 December 1995, *J. Egan 5212* (DNA, MEL); Stuart Hwy/Edith Ck crossing, 17 December 1990, *M. Evans 3515* (DNA, K); Melville Is. on road to Poonali, 1 February 1992, *R. Fensham 1206* (DNA); Melville Is., 18 September 1986, *R. Fensham 308* (DNA); Melville Is., 25 October 1986, *R. Fensham 357* (DNA); road to Matt Wilson lookout, Gregory N.P., 12 January 1998, *R.K. Harwood 284* (DNA); 20 km WSW of Dorisvale homestead, Plot 776, 25 September 1998, *R.K. Harwood 509* (DNA); Gove, 1 June 1981, *D. Hinz 81168* (DNA); Nhulunbuy, 9 June 1982, *R.C. Hinz 127* (DNA); Glencoe Stn, 1892, *N. Holtze 1362* (MEL); 41 km N of Pine Creek turn-off on Stuart Hwy, 5 October 2001, *A.M. Hope 6 & D. Dixon* (DNA); Nitmiluk N.P., near Douglas Springs, Marrawal Plateau, 5 May 2002, *R.A. Kerrigan 587* (DNA); 3 miles [4.8 km] N of Katherine, 15 August 1963, *M. Lazarides 6994* (DNA); *c.* 29 miles [46 km] SW of Nourlangie Safari Camp, 25 February 1973, *M. Lazarides 7846* (CANB, DNA, PERTH); Fossil Head, 23 February 1994, *G.J. Leach, 4225* (BRI, DNA); 10 miles [16 km] NW of El Sharana, Pine Creek road, 22 January 1973, *P. Martensz 465 & R. Schodde* (BRI, CANB, DNA, NT); Bathurst Is., Point Fawcett, 1 May 1998, *C.R. Michell 1415 & R.K. Harwood* (DNA); Edith River area, railway transect 11.1, 13 March 1999, *C.R. Michell 2323 & J.A. Risler* (DNA); Edith River area, 16 March 1999, *C.R. Michell 2399 & J.A. Risler* (DNA); Gregory N.P., Matt Wilson sector, fire plot 2, 17 May 1999, *C.R. Michell 2401 & A.H. Johnson* (DNA); Nitmiluk N.P., Marrawal Plateau Nth, 8 April 2002, *C.R. Michell 3741* (DNA); Nitmiluk N.P., Marrawal Plateau Nth, 9 April 2002, *C.R. Michell 3742* (DNA); Nitmiluk N.P., NE corner, 11 April 2002, *C.R. Michell 3743* (DNA); Cape Wessel, W of Nhulunbuy, 16 December 1998, *A.A. Mitchell 5602c* (DNA); Daly River road, near Adelaide River, 5 October 1962, *J.S. Muspratt 70* (DNA); Fenton Airstrip, 23 October 1974, *J. Must 1284* (CANB, DNA, MO, NT); Melville Is., E side of Brenton Bay, Plot 2797, 14 April 2000, *J.A. Risler 396 & C.P. Mangion* (DNA); Tipperary, Mt Pleasant, 17 February 1968, *C.S. Robinson 42* (DNA); Buckingham R catchment, 5 December 1987, *J. Russell-Smith 4413* (BRI, DNA); 1 km S of Adelaide River Crossing on Daly River road, 19 October 1988, *J. Russell-Smith 6323* (DNA); Mount Wilson area, Gregory N.P., 27 December 1990, *J. Russell-Smith 8452 & D. Lucas* (DNA, PERTH); Eastern Arnhem Land, Baralminan, 2 April

1992, *J. Russell-Smith 8590* (BRI, DNA); Manbulloo Stn, Limestone Ck area, 27 November 1996, *N.M. Smith 3924* (DNA); Darwin, *W.B. Spencer s.n.* (NSW); Kintore Caves Reserve, 5 March 1996, *S. Taylor 362 & D.J. Liddle* (DNA); Gregory N.P., 6 km NE of Bullita Outstation, 8 February 1986, *B.G. Thomson 1124* (DNA); Gregory N.P., 15 km E of Victoria River Inn, 27 February 1986, *B.G. Thomson 1238* (DNA); Victoria River, Gregory N.P., 25 February 1986, *G.M. Wightman 2771* (DNA); Cape Fewcett, Bathurst Is., 8 April 1987, *G.M. Wightman 3586 & N.M. Smith* (DNA); Cato River mouth area, Djurlpungbuy, NE Arnhem Land, 16 February 1988, *G.M. Wightman 4214* (DNA, MEL).

Description. Leaf slightly to strongly discolorous, undersurface usually hoary or grey-green when young becoming less so with age, upper surface with sparse to scattered hairs. Capsule 6–12 mm diam., with a moderately dense covering of sessile stellate hairs, stellate-hairy bristles usually absent or scattered, rarely to 2 mm long. Flowers: Sept.–Feb. Fruits: Feb.–June.

Distribution and ecology. The subspecies is endemic to the northern N.T., from Melville Island to Victoria River and east to Gove Peninsula. It grows in *Eucalyptus* woodland on sandy, clayey or lateritic soils. It flowers profusely on the new growth early in the wet season.

Notes. This subspecies has also been referred to as *Helicteres* D20342 Gove (*G.M. Wightman 3410*) on herbarium specimen labels and unpublished checklists lists from DNA.

The holotype bears Mueller's field label with the name "*Methorium dentatum* n. sp." and Bentham (1863) clearly ascribes the epithet to Mueller.

There is an additional collection of Mueller's at MEL labelled "Sea Range [Yambarran Range], Oct [18]55" (MEL222177). While the corner of the label of this collection has been annotated with a 'B' to indicate it was apparently seen by Bentham and presumably formed part of the original material used to describe *H. dentata*, he does not cite it specifically.

Specimens on both the K and MEL sheets are at a similar stage of growth and it is plausible that they are in fact part of the same gathering. Despite the Upper Victoria River locality on the label of the K sheet, the October collection date indicates that it was probably collected a little further inland than the vicinity of the depot established by Gregory on the upper Victoria River estuary *c.* 12 km west of the modern township of Timber Creek (Gregory & Gregory 1884). This locality is only 30 km or so from Yambarran Range, the location on the MEL sheet. Because of this uncertainty, the Sea Range specimen at MEL is included here as a possible isotype.

Helicteres kombolgiana Cowie, sp. nov.

(Figs 3D–G, 4, 11, 12)

Helicteres integrifoliae affinis, sed habitu erecto, caulibus paucis, partibus supra terram perennibus, ramulis et calyce setis pilos stellatos ferens, foliis et ramulis pilos duarum classium amplitudinum ferens, foliis parvioribus acutis, carpellis rostris longis, inflorescentiis brevibus, floribus paucis distinguit.

Type: Australia, N.T., cultivated at 18 Widdup Cres., Driver, 13 May 2007, *I.D. Cowie 11740* (HOLOTYPE: DNA; ISOTYPES: BRI, CANB, K, L, MEL, MO, NSW).

Other specimens examined. NORTHERN TERRITORY. Mt Brockman Range, 13 km S of Jabiru, 23 February 1973, *L.G. Adams 3089* (CANB, DNA); Nourlangie Rock car park, 16 May 1995, *R. Booth 960* (DNA); Kakadu N.P., below Brockman massif, 1 April 1990, *K.G. Brennan 216* (DNA); Nourlangie Rock near main galleries, 28 December 1991, *K.G. Brennan 1741* (DNA); Kakadu fire plot 132, Leichhardt Spring, 23 March 1999, *K.G. Brennan 3809* (DNA); Upper Deaf Adder Ck, Kakadu fire plot 63, 21 March 2009, *K.G. Brennan 7930* (DNA); Upper Liverpool River, on road between Kulnguki and Mirbik, 22 April 2009, *K.G. Brennan 8011* (DNA); Kakadu N.P., Birdie Ck, 18 April 1990, *I.D. Cowie 1091 & G.J. Leach* (DNA); Koongarra Saddle, 1 January 1992, *I.D. Cowie 2144* (DNA); Arnhem Land, Magela Ck upper catchment, 11 April 1995, *I.D. Cowie 5604 & K.G. Brennan* (DNA); Kakadu N.P., near East Alligator River, W of Rock Holes, 20 April 1999, *I.D. Cowie 8299* (DNA); *c.* 24 km E Myra Falls, Western Arnhem Land, 17 March 2000, *I.D. Cowie 8578* (DNA); Western Arnhem Land, Magela Falls Gorge, 23 August 2004, *I.D. Cowie 10271 & Crase, B.* (DNA); cultivated at Palmerston from seed collected at Magela Falls, 6 June 2006, *I.D. Cowie 10644* (DNA); Palmerston, Widdup Cres, cultivated, 5 January 2010, *I.D. Cowie 12530* (CANB, DNA, SING); Little Nourlangie Rock, 19 March 1979, *C.R. Dunlop 4767* (DNA); Little Nourlangie Rock, 12 May 1978, *C.R. Dunlop 4830* (DNA); Jim Jim Falls, 26 March 1982, *C.R. Dunlop 6227* (BRI, DNA); Mount Brockman, Kakadu N.P., 27 March 1995, *J. Egan 4528* (DNA); Kakadu N.P., 10 km NNE of Jabiru, 28 April 1995, *J. Egan 4855 & Knox, S.F.* (DNA); Kakadu N.P., Baroalba Springs, 25 May 1983, *P. Fryxell 4272* (CANB, DNA); Kakadu N.P., Mt Brockman, 22 May 1980, *M. Lazarides 8908* (AD, CANB, DNA, MEL); Kakadu Nat. Park, 14 km E of Sleisbeck, 18 April 1990, *G.J. Leach 2755 & I.D. Cowie* (BRI, DNA, MEL); 2 km W of Nabarlek Airstrip, 24 April 1979, *M. Rankin 2170* (DNA); Koongarra Jump-up, 12 June 1978, *B. Rice 2925* (CANB, DNA); 5 km from Oenpelli, 21 July 1983, *J. Russell-Smith 777* (DNA); Goomadeer, escarpment country, 28 October 1987, *J. Russell-Smith 3830 & D. Lucas* (DNA); Upper East Alligator River, Arnhem Land, 19 April 1988, *J. Russell-Smith 5243 & D. Lucas* (DNA); Kakadu, 16 June 1988, *J. Russell-Smith 5681* (DNA); Mt Brockman outlier, Kakadu N.P., 20 April 1989, *J. Russell-Smith 8039* (DNA); 12 km E. of Mudginberri Homestead, Kakadu N.P., 7 January 1991, *J. Russell-Smith 8411 & J. Brock* (DNA); Upper Magela Ck valley, Arnhem Land, 3 May 1991, *J. Russell-Smith 8461 & J. Brock* (DNA); Upper Magela Ck valley, Arnhem Land, 3 May 1991, *J. Russell-Smith 8467 & J. Brock* (DNA); Kakadu N.P., Koongarra Area, 16 April

1992, *J. Russell-Smith 8638 & D. Lucas* (DNA); Magela Ck catchment, Kakadu N.P., plots 7B2, 6B1, 13 April 1995, *J. Russell-Smith 10348 & D. Lucas* (DNA, SING); Deaf Adder Ck, Gorge, 22 April 1980, *I.R.H. Telford 7997 & J. Wrigley* (CANB); 6.5 km SSW Mt Brockman, 23 April 1980, *I.R.H. Telford 8040 & J. Wrigley* (CANB); 0.5 km NE Koongarra Saddle, 16 August 1980, *I.R.H. Telford 8421 & J. Wrigley* (CANB).

Description. Open, perennial shrub to 3 m tall, stems few, much branched. Branchlets, young growth, stipules and leaf surfaces covered with a mid-dense to very dense, white indumentum (hyaline on leaf upper surfaee) of sessile stellate hairs of 0.1–0.3 mm diam., grading into an overlying layer of stipitate stellate hairs 0.5–1.2 mm diam. Calyx also with scattered bristles to 0.7 mm long, bearing stellate hairs. Stipules caducous, subulate, 2.5–5 mm long. Petiole 3–10 (19) mm long. Leaf lamina antrorse, lanceolate to ovate or elliptic, 25–70 (105) mm long, 10–35(60) mm wide, 1.6–3 times longer than wide, slightly to strongly discolorous, hoary or grey-green below when young, base cordate to rounded, symmetric to slightly asymmetric, 3–5-nerved, margins serrate, apex acute to sometimes obtuse. Inflorescence axillary, to 10 mm long, few-flowered (often a single dichasium), extra-floral nectaries present; dichasia 1–2-flowered; bracts 2.5–5 mm long, subulate; pedieels 0–1 mm long. Calyx tubular to obovoid-urceolate, 4–6.5 mm long, basal nectary incomplete, truncate; lobes triangular or narrowly triangular, 1–4 mm long. Corolla weakly 2-lipped. Petals mauve, the upper pair paler than lower 3, slightly dimorphic, 5.5–9 mm long, long clawed, limb euneate, with scattered minute erect hairs, with a callus near base, apex truneate to rounded; lower 3 slightly longer than upper pair, claw with 2 small appendages, callus woolly hairy; upper pair broader, with 2 prominent appendages on claw (one adaxial, one lateral), callus glabrous, smooth. Androgynophore 3–5 mm long, straight, shorter than calyx; stamens 10, shortly connate at base, *c.* 0.7 mm long; anthers transverse; staminodes 5, spathulate-acute. Style straight, 1–1.5 mm long; stigma of 5 pin-like lobes, terete. Capsule ovoid to subglobular, 10–22 mm long, *c.* 12 mm diam., densely covered with floecose bristles to 4 mm long, bristles bearing stellate hairs 0.6–0.8 mm diam., styles persisting and forming a beaked apex; carpels straight, 2–5-sceded. Seeds variously shaped, ellipsoid to obconoidal or subrhomboidal, often laterally compressed, *c.* 3 mm long, *c.* 2.5 mm wide, irregularly rugose, dark brown. Flowers: Jan.–May. Fruits: Jan.–July.

Distribution and ecology. Endemic to the northern N.T., in Kakadu N.P. and adjacent areas of western Arnhem Land, almost to Maningrida. Grows in *Allosyncarpia* forest or *Eucalyptus* woodland, on sandy soils on screc slopes or closely associated with other outcropping sandstone.

Notes. This species is allied to *Helicteres integrifolia* but distinguished by the erect habit, few-stemmed perennial above-ground parts, branchlets and calyx with bristles

Fig. 11. *Helicteres kombolgiana*. Flower and leaf. (*I. D. Cowie 10644*).

Fig. 12. Holotype of *Helicteres kombolgiana*.

bearing stellate hairs, hairs of two size classes on the leaves and branchlets; the smaller and acute leaves; long, beaked apices of the carpels and short, few-flowered inflorescenees. The open, mueh branched, few-stemmed growth habit of this taxon is maintained in cultivation.

The type collection was grown from seed gathered from *I.D. Cowie 10271*, collected at Magela Gorge Falls, N.T.

This species has been referred to as *Helicteres* A63558 Kakadu and *Helicteres* sp. Kakadu (*L.G. Adams 3089*) on

herbarium specimen labels and unpublished checklists from DNA.

Etymology. A reference to the Kombolgie sandstone of the western Arnhem Land Plateau, on which geological unit the plant occurs.

Helicteres macrothrix Cowie, sp. nov.

(Figs 4, 7A–E, 13, 14)

Ab *Helicteres integrifolia* et speciebus cognatis inflorescentiis congestis, indumento densissimo, pilis grandioribus, diametro 1.5–4.5 mm, androgynophoro breviore, capsulis dense hirsutis diagnoscenda. Affinis *Helicteres darwinensis* Cowie, sed ea habitu erecto, multicaule, inflorescentiis congestis, indumento densissimo, pilis grandioribus distincta.

Type: Australia, N.T., Stuart Hwy, near Glenluckie Creek, 9 November 1990, *I.D. Cowie 1410 & C.R.Dunlop* (Holotype: DNA; Isotypes: BRI, CANB, K, NSW, MEL, PERTH).

Other specimens examined. NORTHERN TERRITORY. 54 miles [86 km] S of Darwin, Stuart Hwy, 10 January 1969, *N.B. Byrnes 1280* (DNA); near Glenluckie Ck, Stuart Hwy, 25 January 1991, *I.D. Cowie 1481 & C.R. Dunlop* (DNA); near Glenluckie Ck, Stuart Hwy, 15 March 1991, *I.D. Cowie 1565 & P.F. Munns* (DNA); Marrakai Road, W of turnoff to Lake Bennett, 29 November 2002, *I.D. Cowie 9654* (DNA); near Lake Bennett, E side, 29 November 2002, *I.D. Cowie 9656 & R.A. Kerrigan* (DNA); Lake Bennett, *c.* 70 km S Darwin, 26 January 1994, *C.R. Dunlop 9805* (BRI, DNA); 8.4 km W of Annaburroo, 12 September 1992, *J. Egan 402* (DNA); 8 km W of Annaburroo, 12 September 1992, *J. Egan 403* (DNA); 8 km W of Annaburroo, 1 October 1993, *J. Egan 902* (DNA); Annaburroo, 8 km E of dam, 10 January 1993, *J. Egan 903* (DNA); Arnhem Hwy, near Annaburroo, 27 March 1995, *J. Egan 4472* (DNA); Mt Bundey area, 8 km W of Annaburroo, near Arnhem Hwy, 14 November 2001, *A.M. Hope 23 & I.D. Cowie* (DNA, SING); Mt Bundey area, 8 km W of Annaburroo, near Arnhem Hwy, 14 November 2001, *A.M. Hope 24 & I.D. Cowie* (DNA); Mt Bundey area, 6.5 km W of Bark Hut/Annaburroo, 14 November 2001, *A.M. Hope 27 & I.D. Cowie* (DNA).

Description. Erect, multi-stemmed subshrub to 0.6 m, with annual above-ground parts and a woody perennial rootstock. Vegetative parts, calyx and bracts usually with a dense to very dense indumentum of multiangulate stellate trichomes 1.5–4.5 mm diam., sessile or on stipes to 1.5 mm long. Stipules linear, 6–12 mm long. Petiole 0–5 mm long. Leaf lamina ovate, occasionally elliptic or broadly ovate, 50–170 mm long, 40–110 mm wide, 1.3–1.7 times longer than wide, discolorous, base shallowly cordate or rounded, margins serrate to dentate, apex acute to obtuse. Inflorescence axillary, congested, cymose, to 40 (70) mm long, with up to 12 flowers, dichasia 2-flowered; extra-floral nectaries present; bracts linear, 8–13 mm long; pedicels 0–1 mm long. Calyx ellipsoid or ovoid, 6–11 mm long, basal nectary incomplete, margin entire; lobes 2–6 mm long, triangular. Corolla not or scarcely 2-lipped. Petals mauve-pink, weakly dimorphic, 9–14 mm long, glabrous on exterior (abaxial) surfaces, limb cuneate to obcordate, callused near base; lower 3 petals with 1 or 2 small appendages on margin of claw, callus woolly hairy; upper pair with 2 prominent appendages on claw, callus smooth, shiny, glabrous. Androgynophore 3–4 mm long, straight; stamens 10, shortly connate at base, *c.* 1 mm long; anthers transverse; staminodes 5, spathulate-acute, *c.* 0.7 mm long. Style *c.* 1.5 mm long; stigma of 5 pin-like lobes, terete. Capsule ellipsoid, 13–17 mm long, indumentum very dense, of long-stalked stellate hairs or bristles to 6 mm long each bearing 2–5 stellate hairs, apex attenuate; carpels 3–5-seeded. Seeds rhomboidal, truncate, 3–3.5 mm long, *c.* 2 mm wide, finely rugose, brown. Flowers: Nov.–Mar. Fruits: Jan.–Mar.

Fig. 13. *Helicteres macrothrix*. Flowers and leaf base. (*I. D. Cowie 1481*).

Distribution and ecology. The species is endemic to the northern N.T. and known from three subpopulations between Batchelor and Mt Bundey. It grows in *Eucalyptus tectifica* or *E. miniata* woodland on clayey soils derived from siltstone or sandy soil derived from granite.

Notes. This species may be distinguished from *H. integrifolia* and related species by the erect multi-stemmed habit, congested inflorescences, very dense indumentum of long stellate hairs and comparatively small flowers. It is allied to *H. darwinensis*, but distinct from it by the erect multi-stemmed habit, more compact inflorescences, and the indumentum of long stellate hairs, denser and coarser on most parts.

The isotype specimens were unfortunately dispersed before examination for preparation of this description and are without *determinavit* slips indicating their type status.

This species has been referred to as *Helicteres* D2164 Glenluckie Ck and *Helicteres* sp. Glenluckie Ck (*N.B. Byrnes 1280*) on herbarium specimen labels, unpublished checklists lists, other literature (e.g. Kerrigan & Cowie 2007) and listings under the N.T. Government *Territory Parks and Wildlife Conservation Act* and Commonwealth

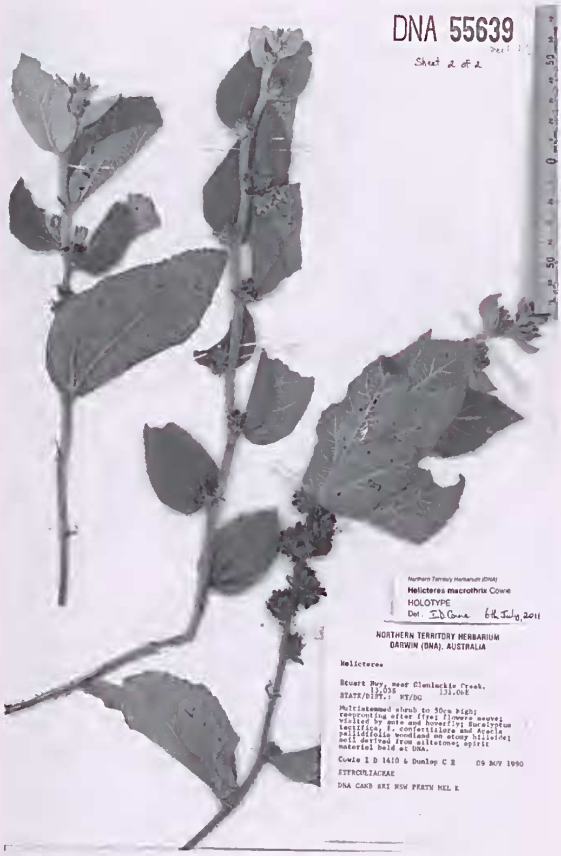

Fig. 14. Holotype of *Helicteres macrothrix*.

Government *Environment Protection and Biodiversity Conservation Act*.

Etymology. From the Greek *macro* – large and *thrix*, a hair, a referenee to the unusually large hairs present in this speeies.

Helicteres procumbens (F. Muell ex Benth.) Cowie, comb. et stat. nov.

(Figs 4, 15).

Helicteres dentata var. *procumbens* F. Muell. ex Benth., *Flora australiensis* 1: 233 (1863); *H. semiglabra* var. *procumbens* (F. Muell. ex Benth.) F.M. Bailey, *The Queensland Flora* 1: 142 (1899).

Type citation: Maeadam Range. **Type details**: Australia, N. T., M'Adam Range (K), between Maeadam Range and Providence Hill (MEL), Oet. 1855, *F. Mueller* (HOLOTYPE: K, *n.v.*, photo DNA; ISOTYPE: MEL (MEL222174)).

Other specimens examined. WESTERN AUSTRALIA. 58 miles [93 km] N of Kununurra, 2 June 1969, *F.C.J. Lullfitz & N. Mackenzie* (PERTH); Vieinity of Kimberley Researeh Station, *D.H. Mackenzie 691102-19* (CANB). NORTHERN TERRITORY. Litchfield Station, 2 miles [3.2 km] SW of homestead, 3 May 1968, *N.B. Byrnes 665* (DNA, NT); headwaters of Lalngang Ck, 16 May 1994, *I.D. Cowie 5075 & N. Walsh* (CANB, DNA, MEL); Daly River road, *c.* 0.5 km N of Silver Mine Ck, 3 Deeember 2002, *I.D. Cowie 9660 & C.P. Mangion* (B, BRI, CANB, DNA, MEL, MO, NSW); Daly River road, *c.* 10.7 km N of Daly River Police Stn, 3 December 2002, *I.D. Cowie 9662 & C.P. Mangion* (B, BRI, CANB, DNA, MEL, MO, NSW); Daly River road, *c.* 12.7 km N of Daly River Poliee Stn, 3 Deeember 2002, *I.D. Cowie 9663 & C.P. Mangion* (BRI, DNA, SING); Daly River road, 12.7 km N of Daly River Poliee Stn, 17 Deeember 2004, *I.D. Cowie 10343* (B, DNA, L, MEL, MO); *c.* 12 km N of Daly River Police Stn, 22 May 1983, *P. Fryxell 4246* (CANB, DNA); Peppimenarti, Moyle River, 31 Oetober 2000, *A.A. Mitchell 6406* (CANB); Kurrowa Ck, Daly River Reserve, 16 October 1988, *J. Russell-Smith 6295* (DNA); Litehfield N.P., 27 April 1995, *S. Taylor 280* (DNA); Daly River Mission area, 26 February 1992, *G.M. Wightman 5642* (DNA); Daly River Mission area, 24 Mareh 1993, *G.M. Wightman 6026* (DNA).

Description. Multi-stemmed subshrub, with prostrate annual above-ground stems to 0.5 m long and a woody perennial root stock. Upper leaf surfaee with sparse long simple or stellate hairs, leaf undersurfaee and branchlets with sparse sessile stellate hairs, moderately dense on ealyx, stipitate stellate hairs usually absent. Calyx with bristles present towards apex. Stipules eaduceous or persistent, subulate, 2–6 mm long. Petiole 1.5–5 mm long. Leaf lamina patent, ovate to oblong-ovate or broadly ovate, rarely elliptie, 2.5–8.5 em long, 1.7–4.8 em wide, 1.4–2.2 times longer than wide, slightly diseolorous, base eordate to rounded, asymmetrie, 3-nerved, margins entire to serrulate, apex acute to rounded. Inflorescenee axillary, eymose, to 40 mm long, few-many flowered, glands absent; bracts 1–4 mm long, subulate; pedicels 1–6 mm long. Calyx tubular, 3.5–5.5 mm long; lobes triangular, 1.5–2 mm long. Corolla not 2-lipped. Petals mauve-pink, slightly dimorphie, 6–9.5 mm long, long clawed, limb euneate, with seattered minute ereet hairs, with a callus near base, apex truneate to obliquely truneate, irregular; lower 3 slightly longer than upper pair, claw with 2 small appendages, eallus woolly hairy; upper pair with 1 or 2 prominent appendages on claw, callus glabrous, smooth. Androgynophore 4–4.5 mm long, straight; stamens 10, *c.* 0.5 mm long; staminodes 5. Style *c.* 1 mm long; stigma of 5 pin-like lobes, terete. Capsule ellipsoid, 6–14 mm long, 6–8 mm diam., with a moderately dense eovering of sessile stellate hairs, and stellate-hairy bristles to 1 mm long; earpels straight, 2–3-seeded, styles eaduceous. Seeds not seen. Flowering: Oet.–Dec. Fruiting: Mar.–May.

Distribution and ecology. In the northern N.T. and adjaeent W.A., from near Kununurra to Litehfield N.P. In D.R., known from near Daly River settlement and along the Daly River road to the western side of Litehfield N.P. Grows in *Eucalyptus* woodland on sandy soils.

Notes. The MEL sheet bears three labels, the middle elearly in Bentham's hand writing reading "Both I believe forms of *H.* (*Methorium*) *dentata* of which we have many"

Fig. 15. *Helicteres procumbens*. Flowers and leaves. (*I. D. Cowie 9660*).

and the K sheet with Bentham's determination "*H. dentata* var. *procumbens*" written on the sheet, indieating both were seen by him. While the type details apparently vary slightly between the K and MEL sheets, one is regarded here as an abbreviated form of the other, perhaps written in haste during the preparation of duplieates. The speeimens are a good mateh and it appears that they form part of the same gathering. The holotype bears Mueller's label with the name "*Methorium procumbens* n. sp.". Although Bentham (1863) does not aseribe the epithet to Mueller, he has elearly used Mueller's name and the authorship ean thus be eited as "*Helicteres procumbens* F.Muell. ex Benth.".

Helicteres procumbens differs from *H. integrifolia* by the prostrate habit, laek of infloreseenee glands, leaves with a sparse indumentum below (not hoary or grey-green) and presenee of long simple or sessile stellate hairs on the upper surfaee. It is also similar to *H. flagellaris*, but *H. procumbens* has a short infloreseenee whieh laeks glands, shorter petals, a shorter androgynophore and eaducous stipules.

Helicteres serpens Cowie, sp. nov.

(Figs 4, 7J–N, 16)

Helicteres darwinensi similis, sed stipulis deeiduis, petiolis saepe longioribus, infloreseentiis apertis, panieulatis, 30–140 mm longis, braeteis 4–7 mm longis, petalis 8–12 mm longis, androgynophoro breviore, eapsula setis ad 2.5 mm longis dense teeta distans.

Type: Australia, N.T., Cutta Cutta Caves Reserve, 17 Deeember 1992, *J. Egan 556* (HOLOTYPE: DNA; ISOTYPES: BRI, *n.v.*, CANB, *n.v.*, MEL, *n.v.*, MO, *n.v.*, K, *n.v.*)

Other specimens examined. NORTHERN TERRITORY. Gunlom-Pine Creek road. 1.5 km toward S Alligator River from ereek marked Plum Tree Ck, 12 Deeember 1991, *K.G. Brennan 1681* (DNA); Kakadu N.P., in hills W of Barramundi Gorge, 12 January 1992, *K.G. Brennan 1770* (DNA); Kakadu N.P., fire plot 33, 29 February 2000, *K.G. Brennan 4874* (DNA); Nitmiluk N.P., veg site 130, 13 February 2001, *K.G. Brennan 5254* (DNA); Katherine Gorge N.P., 24 April 1968, *N.B. Byrnes 627* (DNA, NT); Plum Tree Ck, 20 January 1969, *N.B. Byrnes 1370* (BRI, DNA); Waterfall Ck, S Alligator, 5 January 1972, *N.B. Byrnes 2449* (DNA); road to El Sharana, 20 Mareh 1987, *M.J. Clark 915* (DNA); Kakadu N.P., near Kurundie Ck, 20 April 1990, *I.D. Cowie 1174 & G.J. Leach* (DNA); near Mary River Ranger Station, 7 Deeember 1990, *I.D. Cowie 1456 & C.R. Dunlop* (DNA); *c.* 10 km S of Cutta Caves T/off, Stuart Hwy, 10 Deeember 1991, *I.D. Cowie 2139* (DNA, SING); Arnhem Land, headwaters of Cadell River, *c.* 99 km S Maningrida, 22 Mareh 2000, *I.D. Cowie 8708* (DNA); Headwaters of Cadell River, *c.* 82 km SSE Maningrida, Arnhem Land, 14 April 2000, *I.D. Cowie 8843* (DNA); Katherine Gorge N.P., 7 April 1981, *L. Craven 6721* (DNA, MEL); King River Valley road, 3 January 1993, *J. Egan 821* (DNA); Cutta Cutta Caves Reserve, 18 January 1993, *J. Egan 1130* (DNA); King River Valley road, 14 February 1993, *J. Egan 1460* (DNA); Cutta Cutta Reserve, 9 Mareh 1993, *J. Egan 1816* (DNA); King River Valley road, 9 Mareh 1993, *J. Egan 1817* (DNA); 50 km N of Mataranka, 15 April 1993, *J. Egan 2059* (DNA); Edith Falls N.P., 15 April 1995, *J. Egan 4759* (DNA); Nitmiluk, near visitor eentre, 14 Deeember 1990, *M. Evans 3483* (BRI, DNA); *c.* 12 km N Korlobidahda, plot 2243, 23 Mareh 2000, *R.K. Harwood 881* (DNA); El Sharana Rd, 43 miles [69 km] from Pine Creek, 12 January 1973, *D. Hearne 390* (DNA); Nitmiluk N.P., Marrawal Plateau, 3 May 2002, *R.A. Kerrigan 586* (DNA); Nitmiluk N.P., Eva Valley Boundary, 8 Mareh 2002, *R.A. Kerrigan 588* (DNA); Florina site, 19 miles [30 km] SE of Katherine, 9 Deeember 1963, *M. Lazarides 6969* (CANB, DNA, PERTH); 24.5 miles [39 km] NNW El Sharana Mine, 25 February 1973, *M. Lazarides 7852* (CANB); 13 miles [21 km] E of El Sharana Mine, 2 Mareh 1973, *M. Lazarides 7976* (BRI, CANB, DNA, MEL); Headwaters Koolpin Ck, 20 April 1995, *G.J. Leach 4379* (DNA); Kakadu N.P., S of Plum Tree Ck, 6 January 1995, *D. Lucas 9166 & J. Russell-Smith* (DNA); 4m [6 km] NNW of El Sharana, 18 January 1973, *P. Martensz 406 & R. Schodde* (BRI, DNA); UDP Falls, near El Sharana, 13 January 1973, *J.L. McKeau 868* (DNA); Nitmiluk N.P., 28 February 2001, *C.R. Michell 3299* (DNA); Nitmiluk N.P., Nit 2000, 9 February 2001, *C.R. Michell 3300* (DNA); Nitmiluk N.P., SE eorner of park, 14 Mareh 2002, *C.R. Michell 4172* (DNA); Kakadu Stage 3, SE of Sleisleek, 18 April 1990, *T. Orr 370* (DNA); Kakadu Stage 3, E of Coronation Hill, 18 April 1990, *T. Orr 400* (DNA); Mataranka, 31 July 1980, *M. Rankin 2543* (DNA); Nitmiluk N.P., Site 432, 3 April 2001, *J.A. Risler 1303 & M. Waetke* (DNA); Nitmiluk N.P., site 491, 17 April 2001, *J.A. Risler 1304 & M. Waetke* (DNA); Kakadu, Graveside Gorge, 3 May 1987, *J. Russell-Smith 2270* (DNA); Kakadu N.P., Round Jungle, 5 February 1995, *J. Russell-Smith 9444 & D. Lucas* (DNA); Kakadu N.P., near Kombolgie Ck crossing on UDP Falls road, 1 May 1990, *A.V. Slee 3071 L. Craven* (AD, DNA, MEL); 3 km W Barunga Community, 2 February 1987, *N.M. Smith 342* (DNA); White stone area near Barunga Community, 12 Deeember 1996, *N.M. Smith 3947* (DNA); Eva Valley Station, 16 January 1989, *B.G. Thomson*

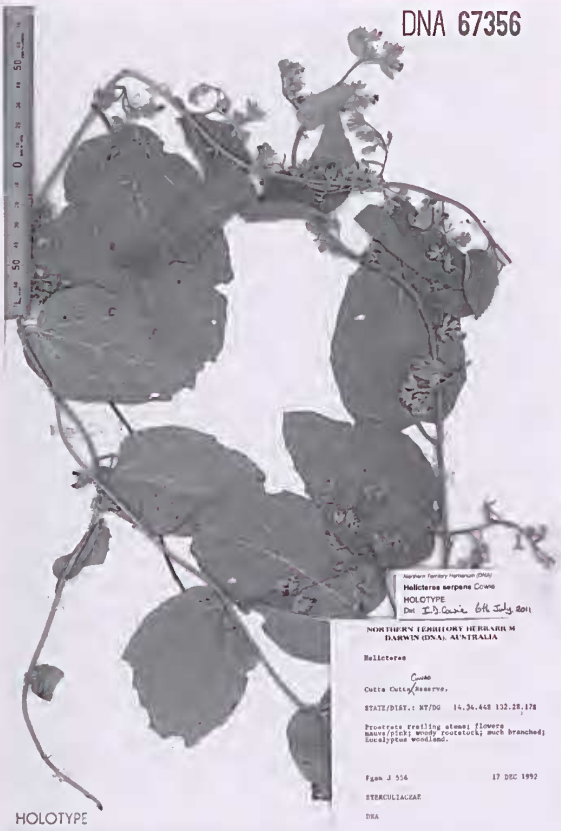

Fig. 16. Holotype of *Helicteres serpens*.

2824 (DNA); Cutta Cutta Caves Reserve, 6 February 1989, *B.G. Thomson 3268* (DNA); Gorge between Twin Falls & Jim Jim Falls, 24 March 1984, *G.M. Wightman 1328* (DNA); Nitmiluk N.P. Ranger H.Q, 13 December 1990, *G.M. Wightman 5204 & T. Presnell* (DNA).

Description. Multi-stemmed subshrub, with prostrate annual above-ground stems to 0.7 m long and a woody perennial root stock. Most vegetative parts and calyx hirsute with sessile or stipitate stellate hairs, sparse to dense sessile stellate hairs on upper surface of leaf lamina. Stipules deciduous, subulate, 4–10 mm long. Petiole 3–40 mm long. Leaf lamina sometimes ground-hugging, lanceolate to ovate, 40–140 mm long, 23–90 mm wide, discolorous when young, hairs of the upper surface 0.4–1.2 mm diam., on the lower surface 0.4–1.7 mm diam., base cordate, asymmetric, 5-nerved, margins irregularly serrate, apex acute to rarely rounded. Inflorescence axillary, open, paniculate, 30–140 mm long, 6–21-flowered, dichasia 1–2-flowered; extra-floral nectaries present; bracts 4–7 mm long, filiform; pedicels 0–3.5 mm long. Calyx funnel-shaped or ellipsoidal-cylindrical, 5–9 mm long, hairs 0.3–1.1 mm diam., basal nectary incomplete; lobes narrowly triangular, 2–4 mm long. Petals mauve-pink, dimorphic, 8–12 mm long, clawed to long clawed, limb cuneate, minutely hairy, callused near base; lower 3 petals slightly longer, with 0–2 small appendages on claw; callus woolly hairy; upper pair with 2 prominent appendages on claw, callus smooth. Androgynophore 3.5–5.5 mm long, straight, distinctly shorter than calyx; stamens 10, shortly connate at base, *c.* 1.5 mm long; anthers transverse; staminodes 5, lanceolate or elliptic, 0.5–0.7 mm long. Style *c.* 1.3 mm long; stigma of 5 pin-like lobes, terete. Capsule ovoid to ellipsoid, 8–20 mm long, 11–14 mm diam., densely covered with stellate-hairy bristles to 5 mm long, hoary, hairs 0.8–1.2 mm diam., styles caducous; carpels straight, 3–5-seeded. Seeds sub-rhomboidal, *c.* 2.7 mm long, 2 mm wide, irregularly rugose, dark brown. Flowers: Dec.–Apr. Fruits: Feb.–June.

Distribution and ecology. The species is endemic to the northern N.T., where it is common from Kakadu N.P. to near Mataranka and east to near Maningrida. It grows in *Eucalyptus* woodland mostly on deep sandy soils.

Notes. Similar to *H. darwinensis* but separated by the deciduous stipules, petioles often longer than in *H. darwinensis* (to 40 mm), the open, paniculate inflorescences 30–140 mm long, the bracts 4–7 mm long, the petals 8–12 mm long, the androgynophore shorter, and the capsule densely covered with bristles to 2.5 mm long.

As with *H. darwinensis*, this species flowers early in the wet season on the shoots of the new growth arising from the woody rootstock. The new growth is very densely hairy and at first acquaintance strikingly different from the sparser indumentum of the mature leaves present later in the wet season. The species shows clinal variation in density of the indumentum with it becoming sparser along a gradient from south of Katherine to Kakadu and Arnhem Land. Specimens from southern Kakadu also have smaller hairs than those from elsewhere.

This species has been referred to as *Helicteres* D4247 elongate and *Helicteres* sp. elongate (*J. Must 887*) on herbarium specimen labels and unpublished checklists from DNA.

Etymology. From the Latin *serpens* – creeping, a reference to the prostrate habit.

Helicteres sphaerotheca Cowie, sp. nov.

(Figs 4, 7O–S, 17)

Ab *Helicteres integrifolia* et specibus cognatis stipulis persistentibus, lamina folii anguste lanceolata ad anguste oblanceolate, 2–7 mm lata, 5–8.5-plo longiore quam latiore, concolora, pagina supera pilis sparsis simplicibus, capsula globosa, setis densis, usque ad 2 mm longis vestita discrepans.

Type: Australia, N.T., Arnhem Hwy, 300 m E of West Branch of West Alligator R, 4 January 1992, *I.D. Cowie 2146* (Holotype: DNA; Isotypes: AD, B, BRI, CANB, CNS, K, L, MEL, MO, NSW, NT, NY, PERTH, SING).

Other specimens examined. NORTHERN TERRITORY. Arnhem Hwy, 300 m E West Branch of W Alligator River, 3 December 1990, *K.G. Brennan 1642* (DNA); Arnhem Hwy, 300 m E of West Branch of W Alligator R, 11

Fig. 17. Holotype of *Helicteres sphaerotheca.*

December 1991, *K.G. Brennan 1676* (AD, BRI, CANB, DNA, K, L, MEL, MO, NSW, PERTH); Arnhem Hwy, *c.* 0.5 km W of W branch of Flying Fox Ck, 29 March 1991, *I.D. Cowie 1594* (BRI, DNA, CANB, PERTH); Kakadu N.P., *c.* 500 m E of W branch of West Alligator River, 9 April 2003, *I.D. Cowie 9750 & D. Dixon;* (DNA); 60 km W of Jabiru, 19 March 1981, *L. Craven 7854 & G. Whitbread* (CANB, DNA, MEL); Kapalga, 12 March 1982, *C.R. Dmlop 6120* (BRI, DNA); Wildman River Reserve, 29 January 1997, *C.R. Michell 348* (DNA).

Description. Erect, multi-stemmed subshrub to 0.6 m, with annual above-ground parts and woody perennial root stock. Most vegetative parts and calyx with sparse sessile stellate hairs, sparse simple hairs on upper surface of leaf lamina. Stipules persistent, setose, 1–2 mm long. Petiole 0.5–1 mm long. Leaf lamina patent to recurved, narrowly lanceolate to narrowly oblanceolate, 15–35 mm long, 2–7 mm wide, 5–8.5 times longer than wide, concolorous, base rounded, symmetric, 3-nerved, margins entire, or irregularly serrate near apex, apex acute to rounded. Inflorescence axillary or terminal on short lateral shoots, cymose, 10–15 mm long, few-flowered, dichasia 3-flowered; extra-floral nectaries present; bracts *c.* 1 mm long, setose; pedicels 1–4.5 mm long. Calyx tubular to funnel-shaped, 3.5–4.5 mm long, basal nectary short, incomplete, truncate; lobes triangular, *c.* 0.5 mm long. Petals mauve-pink, scarcely dimorphic, 7–9.5 mm long, long clawed, limb cuneate, minutely hairy, callused near base, apex obliquely truncate; lower 3 petals slightly longer than upper pair, claw with 1–2 small lateral appendages, callus woolly hairy; upper pair with 2 prominent appendages on claw, callus glabrous, smooth. Androgynophore 4.5–5 mm long, straight, equal in length to calyx; stamens 10, shortly connate at base, *c.* 0.8 mm long; anthers transverse; staminodes 5, spathulate-acute, *c.* 0.7 mm long. Style *c.* 1.3 mm long; stigma of 5 pin-like lobes, terete. Capsule globular, 8–11 mm diam., densely covered with stellate-hairy bristles to 2 mm long, hoary, styles caducous; carpels straight, 1–3-seeded. Seeds sub-rhomboidal, *c.* 2.5 mm long, 2 mm wide, irregularly rugose, dark brown. Flowers: Dec.–Jan. Fruits: Mar.

Distribution and ecology. The species is endemic to the northern N.T., between the Mary River and the South Alligator River. It grows in *Eucalyptus miniata* woodland on sand.

Notes. Differing from *H. integrifolia* and related species by the persistent stipules; the lamina narrowly lanceolate to narrowly oblanceolate, 2–7 mm wide, 5–8.5 times as longer than wide, concolorous, upper surface with sparse simple hairs and the globular capsule with bristles to 2 mm long.

This species has been referred to as "*Helicteres* D21039 linifolia" and "*Helicteres* sp. linear leaves (*L.A. Craven 7854*)" on herbarium specimen labels and unpublished checklists lists from DNA.

Etymolygy: from the Greek, *sphaera* – a ball or globe and *thece* – a case or container, in reference to the globular capsule.

Helicteres tenuipila Cowie, sp. nov.

(Figs 3H–K, 4, 18, 19)

Ab *H. integrifolia* et speciebus cognatis indumento sparsiore et grossiore, foliis oblanceolatis grandis, pilis stellatis sparsioribus in paginis ambabus, parum discoloribus; calycee pilis stipitatis stellatis frequentibus seccedus.

Type: Australia, N.T., Litchfield N.P., opposite turnoff to Green Ant Creek, *I.D. Cowie 10361 & J.L. Egan* (Holotype: DNA (3 sheets); Isotypes: AD, B, BRI, CANB, K, L, MEL, MO, NSW, PERTH).

Other specimens examined. NORTHERN TERRITORY. Stapleton Park, 20 May 1985, *D. Bowman 185 & B. Wilson* (DNA); Litchfield N.P., track to Lost City, 23 November 1990, *I.D. Cowie 1436 & C.R. Dmlop* (BRI, CANB, DNA, K, PERTH); Litchfield Park, near Blythe homestead ruins, 26 November 1992, *I.D. Cowie 3269* (BRI, DNA, MEL); Litchfield N.P., Tabletop Range, 23 March 1995, *I.D. Cowie 5347 & S. Taylor* (DNA); Litchfield N.P., turnoff to Lost City, 20 January 2005, *I.D. Cowie 10362 & J. Egan* (CNS, DNA, SING); Tolmer Plateau, 5 April 1991, *C.R. Dmlop*

Fig. 18. *Helicteres tenuipila*. Flowers and leaves. Inset. Flower (*I. D. Cowie 10361*).

Fig. 19. Holotype of *Helicteres tenuipila*.

8809 & I.D. Cowie (BRI, DNA, MEL); Litchfield N.P., Lost City road, 10 December 1992, *J. Egan 410* (DNA); Litchfield N.P., road to Lost City, 26 December 1992, *J. Egan 646* (DNA); Litchfield N.P., Lost City, 24 January 1993, *J. Egan 1161* (DNA); Litchfield N.P., Lost City road, 17 March 1993, *J. Egan 1762* (DNA); Litchfield N.P., Lost City road, 24 April 1993, *J. Egan 2182* (DNA); Litchfield N.P., 8 March 2006, *J. Egan 5726 & D. Lucas* (DNA); Litchfield N.P., 2 November 1995, *S. Taylor 328* (DNA).

Description. Erect, multi-stemmed subshrub to 0.5 m, with annual above-ground parts and a woody perennial root stock. Most vegetative parts with sparse to moderately dense sessile stellate hairs, denser on calyx, stipitate stellate hairs occasional on stems, common on calyx. Stipules caducous, setose, 5–7 mm long. Petiole 4–7 mm long. Leaf lamina elliptic to oblanceolate or obovate, rarely ovate or lanceolate, 45–95 mm long, 15–40 mm wide, 2.4–3.3 times longer than wide, slightly discolorous, hairs of the upper surface 0.6–1.5 mm diam, on the lower surface 0.4–1.5 mm diam., base cuneate to rounded, symmetric or asymmetric, 3-nerved, margins entire near base, becoming serrate near apex, apex acute to rounded. Inflorescence axillary, umbellate, *c.* 15 mm long, few flowered, extra-floral nectaries present; bracts *c.* 4 mm long, linear; pedicels *c.* 1 mm long; dichasia 2-flowered. Calyx cupular to urceolate, ellipsoid or tubular, *c.* 6 mm long, basal nectary incomplete, margin oblique; lobes triangular, *c.* 1 mm long. Corolla weakly 2-lipped. Petals mauve-pink, the upper pair paler than lower, slightly dimorphic, 7–9 mm long, long clawed, limb cuneate, minutely hairy, callused near base, apex truncate to obliquely truncate; lower 3 slightly longer than upper pair, claw with 0–2 small appendages, callus woolly hairy; upper pair with 2 prominent appendages on claw, callus glabrous, smooth. Androgynophore *c.* 3.5 mm long, straight, shorter than calyx; stamens 10, shortly connate at base, *c.* 0.8 mm long; anthers transverse; staminodes 5, spathulate-acute, *c.* 0.7 mm long. Style 0.8–1.5 mm long; stigma of 5 pin-like lobes, terete, sometimes slightly divergent. Capsule globular to ellipsoid, 12–20 mm long, 10–13 mm diam., densely covered with stellate-hairy bristles to 5 mm long, styles caducous or persistent; carpels straight, 1–3-seeded. Seeds variously shaped, conoidal to depressed cylindric or fusiform, often laterally compressed, 1.5–3.5 mm long, *c.* 2.5 mm wide, irregularly rugose, dark brown. Flowers: Nov.–Dec. Fruits: Jan.–May.

Distribution and ecology. The species is endemic to Litchfield N.P. in the northern N.T., where it is found on the surface and side slopes of the Mt Tolmer Plateau. It grows in *Eucalyptus miniata / E. tetrodonta* open forest on sandy soils.

Notes. It is separated from *H. integrifolia* and allied species by the sparser and coarser indumentum, larger leaves which are oblanceolate, more coarsely and irregularly serrate with sparser stellate hairs on both surfaces, only slightly discolorous, and with stipitate stellate hairs common on the calyx.

Several collections from the Wingate Mountains - Fish River Conservation Reserve are tentatively placed here (*Cowie 12604, 12606; Walsh 3671*). They differ in having narrower, linear leaves 50–100 mm long, 5–11 mm wide, 6.5–19 times longer than wide and a coarser indumentum of stellate hairs 0.7–2 mm diam. with the branches touching to distinctly overlapping, but the underlying surface is highly visible. No flowers have been seen, although the length of both the remains of the persistent calyx and the androgynophore are consistent with *H. tenuipila*.

This species has been referred to as "*Helicteres* D27003 Litchfield" and "*Helicteres* sp. Litchfield (*D.M.J.S. Bowman 185*)" on herbarium specimen labels and unpublished checklists from DNA.

Etymology. From the Latin *tenuis*, thin or fine and *pilus*, a hair, referring to the sparse indumentum of the leaves of this species.

Notes on other species

***Helicteres angustifolia* L.** (not illustrated). The name *Helicteres angustifolia* L. is applied here in a broad sense and may include a number of both described and undescribed taxa (Masters 1874; Backer & van den Brink 1963; Cristobal 2001; Phengklai 2001; Tang *et al.* 2007). Overseas and most Australian material share the following common features of a short, close indumentum on the stems and lower surface of leaves; stipules caducous, 3.5–6 mm long, leaves strongly discolorous, lanceolate to narrowly elliptic (sometimes oblong, ovate or oblanceolate), 2–6.3 times longer than wide, usually glabrous on the upper surface and hoary below, margins entire, inflorescences short, axillary, 2–11-flowered; cincinni 2-flowered, extra-floral nectaries present; calyx 4–8 mm long, weakly 2-lipped, sub-cylindrical; petals 5–11 mm long, weakly dimorphic, mauve or purplish, the lower three with a woolly hairy callus at base of limb; the upper pair with a smooth glabrous area at base of limb, androgynophore 3–7.5 mm long, style apparently with 5 pin-like lobes; capsules ovate to oblong, 7–23 mm long, densely stellate-pilose with bristles absent or up to 4 mm long; and carpels straight, 2–7-seeded. Stellate hairs of the stem and calyx are 0.2–0.8 mm diam. The growth habit is an erect open shrub.

In Australia and overseas, there is variation in indumentum colour, the size and apex of the leaf, the indumentum of the upper leaf surface and in size, apex and indumentum of the fruit. A number of entities can be recognised. Some entities have leaves with the upper surface densely hairy with stellate, or stellate and simple hairs, or may be united by a similar capsule apex and indumentum, but are otherwise not readily distinguished by other characters. Much, but not all, of the variation in individual characters seen in Australian material falls within the range observed in overseas material. Some Australian entities have a localised geographic distribution while others are geographically more scattered, morphologically more variable and scarcely distinguishable from some Malesian material. The name *Corchorus allenii* F.Muell., described by Mueller (1892) from a specimen collected in the Prince Regent River area by Bradshaw and Allen, represents a species of *Helicteres* and is likely to apply to one of the above entities. Further examination of these entities is needed and especially in relation to Malesian material from the Java to New Guinea area where relatively few specimens have been seen.

***Helicteres hirsuta* L.** (Fig. 20). Australian (i.e. N.T.) material of *Helicteres hirsuta* may be worthy of formal recognition as a distinct taxon at some level but further examination of material from India and Lesser Sunda Islands is required. Compared to material from China, Vietnam, Laos, Thailand, Peninsular Malaysia, Borneo, Sumatra, Philippines and Java (largely at SING), N.T. material mostly has a hyaline to stramineous indumentum rather than a hyaline to stramineous or apparently ferruginous one, the leaves are often less densely hairy below, the calyx and corolla are mostly shorter, the androgynophore is almost always shorter (5–12 mm long as opposed to 12–19 mm long) and leaf shape and petiole length are not as variable (although included within the range of variation). However, the apparently darker indumentum may well be an artefact of storage conditions as considerable darkening of specimens within a few years of collection has been observed by the author where specimens are subject to un-aireconditioned storage under tropical conditions. Most of the Malesian material seen was collected pre-1940. Also, specimens of

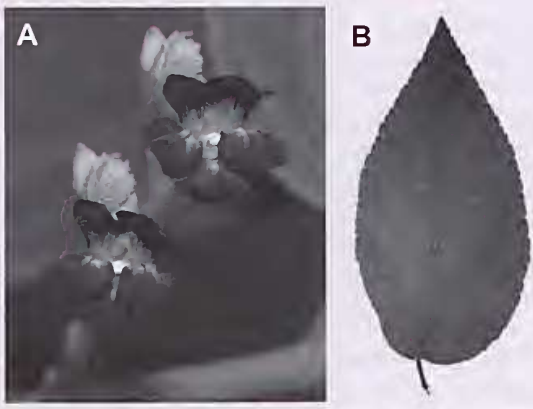

Fig. 20. *Helicteres hirsuta*: **A**, flowers; **B**, leaf. (*I. D. Cowie 10654*).

similar age from China, Vietnam and Philippines at both AD and LUND had only white to stramineous indumentum.

Some Philippine material (e.g. *Borromeo s.n. Aug 1915* (SING), *Acebido 35463* (SING); *Merrill 506, 547* (SING); *Ramos 1437* (SING), *s.n. Nov. 1909* (LD)) has an indumentum density on leaves and stems close to N.T. specimens, with a shorter calyx down to 10 mm long (7–11 mm long in Australian material) and petals down to 15 mm long (11–18 mm long in Australian material). Also, *Chow 78282* (at AD) from China has leaf size and indumentum very similar to Australian material, but with a longer calyx and corolla. No material from the islands east of Java has been seen and it is not clear if the taxon occurs in the Lesser Sunda Islands. Further study of any material from these areas is needed to determine if Australian material is morphologically distinct.

KEY TO SPECIES OF *HELICTERES* IN THE NORTHERN TERRITORY

1 Leaves linear, less than 8 mm wide (Fig 7P–S)..... ..... *H. sphaerotheca*

1: Leaves lanceolate, ovate, elliptic, orbicular or obovate, more than 8 mm wide 2

2 Androgynophore 8 mm or longer; all petals lacking an area of matted hairs at base of limb 3

2: Androgynophore 7 mm or shorter; lower 3 (abaxial) petals with a distinct area of matted hairs at base of limb 5

3 Leaf margins entire, rarely toothed in upper half (Figs 2, 3A–C) ..... *H. cana*

3: Leaf margins toothed throughout..... 4

4 Calyx more than 15 mm long; carpels twisted spirally; inflorescence cymose (Fig. 1)..... *H. isora*

4: Calyx less than 15 mm long; carpels straight; inflorescence racemose (Fig. 20)..... *H. hirsuta*

5 Upper surface of leaves glabrous or nearly so or simple hairs present, with or without stellate hairs 6

5: Upper surface of leaves stellate hairy, sometimes sparsely so, simple hairs absent 8

6 Leaf margins entire; erect shrub; leaves white below ..... *H. angustifolia sens. lat.*

6: Leaf margins serrate; plant prostrate; stems long and trailing in mature plants 7

7 Petals 10–16 mm long; inflorescence 30–140 mm long; extra-floral nectaries present (Fig. 9)... *H. flagellaris*

7: Petals 6–9.5 mm long; inflorescence to 40 mm long; extra-floral nectaries absent (Fig. 15) .... *H. procumbens*

8 Plants prostrate, stems long and trailing in mature plants 9

8: Plants ascending to erect when well developed ... 10

9 Inflorescence elongate, interrupted; usually more than 30 mm long (Fig. 7J–N)..... *H. serpens*

9: Inflorescence contracted, often congested; usually less than 30 mm long (Figs 6, 7F–I)..... *H. darwinensis*

10 Leaf indumentum coarse, hairs mostly more than 1.3 mm diam.; petals 11 mm or more long; stipules more than 6 mm long (Figs 7A–E, 13)..... ..... *H. macrothrix*

10: Leaf indumentum fine to medium, hairs mostly less than 1.3 mm diam.; petals mostly 10 mm or less long; stipules 6 mm or less long (rarely longer in *H. tenuipila*) 11

11 Leaves with sparse hairs on both surfaces, the lower surface green (Figs 3H–K, 18)..... *H. tenuipila*

11: Leaf with the lower or both surfaces densely hairy and obscured, the lower surface often white or grey-green below 12

12 Leaf hairs of two size classes; calyx with bristles and stellate hairs; few-stemmed perennial shrubs to 2 m tall (Figs 3D–G, 11) ..... *H. kombolgiana*

12: Leaf hairs of one size class; calyx with stellate hairs only; multi-stemmed subshrubs to 0.5 m tall resprouting each year from a woody rootstock (Fig. 10) ..... *H. integrifolia*

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